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# Safe Milk 1941

## A SPECIAL MILK NUMBER



### Drink More Milk

Milk—The Protected, Protective Food. Consumption of Milk in Canada. Milk Consumption in the Vancouver Area. An Educational Program to Raise Nutrition Levels through Increased Milk Consumption.

### But Drink Safe Milk

The Production of Clean Milk. Tests for Milk Quality. Transmission of Animal Diseases to Man through Milk. The Present Status of Milk-borne Disease Hazards. Contagious Abortion of Cattle and Undulant Fever in Man. Engineering Features of Pasteurizing Plants and Equipment. Progress in Pasteurization in Ontario. The Phosphatase Test. Survey of Milk Control in Canada. Survey of Certain Milk-borne Diseases in Canada.


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CANADIAN
PUBLIC HEALTH JOURNAL

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# Milk: The Protected, Protective Food

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SCIENTIFIC research in the past twenty-five years has provided information regarding dietary constituents which are necessary for health. It is clearly recognized that the daily intake of food should be sufficient to satisfy the energy requirements of the individual, that there should be ample protein, fat, and all the needed minerals and vitamins. These stipulations become practical only when they are translated into terms of actual foods. It is not difficult to secure an optimal diet and emphasis should be given to the statement that such a supply of food can be secured from Canadian sources.

Recent surveys of food consumption in Canada, the United States, and Great Britain have shown that the outstanding deficiencies are calcium, iron, and the B vitamins. The trend among people who lack a knowledge of nutrition is to purchase foods for their filling ability. It would be better to stint on foods which supply only energy and to make sure of minerals and vitamins. A high intake of energy foods may aggravate a deficiency created by a lack of some of the vitamins.

Because existing data clearly prove that the common mistakes in food habits are failures to ensure adequate supplies of vitamins and minerals, nutritionists have classified foods which furnish excellent quantities of these constituents as protective foods. This simple name indicates the function of these foods: they protect against malnutrition and consequent ill-health. The common protective foods in Canada are: milk, butter, cheese, eggs, meat, fruits and vegetables, whole-grain cereal products. Milk is our most valuable protective food. So much attention has been given to the proper handling of milk in recent years that it is proper to refer to milk as a protected, protective food.

One of the common deficiencies in Canadian diets is a lack of calcium. This element is needed for the formation of bones and teeth; an adequate supply is particularly important for pregnant and nursing mothers and for growing chil-

dren. The need for calcium is greatest during the teen ages. The Canadian Council on Nutrition has recommended the following supplies of calcium:

| | |
|---|---|
| Children up to 10 years of age | 1.0 gram per day |
| Children from the end of the 10th to the end of the 18th year | 1.25 " " " |
| Men | 0.6 " " " |
| Women (except during pregnancy and lactation) | 0.6 " " " |
| Pregnant and nursing mothers | 1.5 " " " |

Milk is the most convenient source of calcium. In an ordinary dietary, three-fourths of the total amount of calcium is supplied from milk. To help ensure an adequate supply of calcium the Canadian Council on Nutrition has suggested minimal standards for the daily supply of milk. These are:

| | |
|---|---|
| From birth to the end of the 6 months of age | 1½ pints daily |
| From the end of 6 months to the end of the 1st year | 1 quart " |
| From the end of the 1st year to the end of the 10th year | 1¼ pints " |
| From the end of the 10th year to the end of the 18th year | 1½ " " |
| Adults (except as noted below) | ½ pint " |
| Pregnant mothers | 1½ pints " |
| Nursing mothers | 1½ " " |

It should be noted that these are minimal standards. A preferable intake for adults would be a pint per day. One pint of milk supplies 0.7 gram of calcium; an adult who drinks a pint of milk each day has ensured the intake of an adequate amount of calcium. A convenient method of remembering the calcium content of milk is the statement that an average glass contains 0.2 gram of calcium. Adults should have three glasses of milk a day.

Milk is not an expensive food. If we set out to buy food calcium in Toronto at present one gram would cost us 10 cents in milk, 33 cents in bread, and $1.00 in eggs. Milk is not the cheapest food source of calcium since cheese furnishes this element more economically. Milk is, however, the most convenient food source and one that can be taken at all ages.

Milk does much more than furnish calcium. It is a solution of protein, sugar, salts and vitamins in water, with fat present in small drops as an emulsion. The physical state of milk is important because it helps to make milk the most digestible of foods. This point can be emphasized by recalling the familiar knowledge that milk is a safe food for persons with gastric ulcers.

In milk there is about 13 per cent of solids and in no other food do we find so many valuable dietary essentials grouped together. Milk contains 3.3—3.4 per cent proteins, and casein, the protein present in largest amount, is the best nutritive protein known. Casein supplies practically all of the essential amino acids and, by doing so, supplements incomplete grain proteins. Milk is not an expensive source of protein. If we assume that the average needed supply of protein for a man is 70 grams per day, that quantity would cost in Toronto at present if secured from milk alone 23 cents, from hamburg steak 16 cents, and from white bread 12 cents. These figures give a misleading impression, however, because the protein in milk has much greater nutritive value than the protein in bread. A completely satisfactory protein supply could be secured by taking two-

thirds of the needed amount in bread and the balance in milk. The cost of such a supply would be 16 cents, which is the cost of protein bought in the cheapest grade of hamburg steak. There is no justification for regarding milk as an expensive food.

Milk also supplies fat and carbohydrate. The fat of milk melts at a lower temperature than most animal fats and this is one reason for the ease with which it is digested. Another factor is the occurrence of the fat as an emulsion. Milk fat is more easily digested and more completely absorbed into the body than any other animal fat.

Milk is a valuable source of two vitamins—A, and riboflavin, one of the B vitamins. Both of these are needed for growth. Vitamin A forms part of the eye pigment, visual purple. This substance is decomposed by exposure to bright light; if new supplies are not made available, vision in subdued light is impaired. New supplies of visual purple cannot be synthesized unless ample vitamin A is available. Hence vitamin A is necessary for the prevention of night blindness. The chief sources of vitamin A in ordinary diets are milk and the related dairy product, butter. The quantity of vitamin A in milk is dependent upon the fodder given to the cow, and the level of the vitamin in milk is at its highest in summer when cows are in pasture. On the average a pint of milk supplies about 600 International Units of vitamin A. Riboflavin is an essential part of a respiratory enzyme needed for normal metabolism. It has been stated that a lack of riboflavin is the most frequent dietary deficiency in the Southern States. One pint of milk will supply 1.3 mg. of riboflavin; a satisfactory daily intake of this vitamin is 2.0 mg. Milk also furnishes significant amounts of thiamin (vitamin $B_1$). A pint of average milk will supply 100 International Units of thiamin. Milk furnishes very little vitamin C and should never be considered a source of the antiscorbutic vitamin.

It is erroneous to refer to milk as a perfect food since it does not supply all needed dietary constituents. It contains comparatively little iron. However, the iron in milk is readily absorbed and is utilized to better advantage than the iron in some other foods.

Available data show that the consumption of milk by many Canadian families is much too small. Nutritionists are agreed that a more generous use of milk is advisable provided that it has been made safe for use. There is only one proved way to make milk safe: pasteurization. Questions are occasionally raised by uninformed persons regarding the effects of pasteurization upon the nutritive value of milk. All sound scientific opinion confirms the statement that pasteurization does not lessen the nutritive value of milk. Scientific evidence coming not only from animal experiments but from studies on humans can be summed up as follows:

1. The excellent nutritive value of milk protein is not impaired by pasteurization.

2. Sugar and fat are not altered.

3. The calcium and phosphorus content of milk is not diminished and both elements are as well absorbed from pasteurized as from raw milk.

4. Pasteurization does not lessen the vitamin A content of milk.

5. Studies of the total nutritive value of milk have shown that it is not altered by pasteurization. This has been clearly proved in studies on children.

If milk has been rendered safe by pasteurization, it can accurately be described as a protected, protective food. It is our most useful protective food because it supplies large amounts of vitamin A and riboflavin and significant amounts of thiamin. It is our most convenient food source of calcium. It contains a protein of high nutritive value and fat of easy digestibility. An increased consumption of milk in Canada would help to improve the nutritional status, and the level of public health, of Canadians.

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## THE CANADIAN PUBLIC HEALTH ASSOCIATION AND PASTEURIZATION*

THE CANADIAN PUBLIC HEALTH ASSOCIATION stands unequivocally for the pasteurization of all milk supplies as the one and only means at our disposal for the final safeguarding of the health of the public from the dangers associated with the consumption of raw milk. This position has been stated and re-affirmed by resolutions at succeeding annual meetings of the Association. In so emphasizing the place of pasteurization in an adequate system of milk control, the Association has not overlooked the fundamental importance of proper inspection of dairy farms and dairy plants, with all that this inspection entails. It is fully recognized that pasteurization can only render a milk safe from the danger of disease transmission. Pasteurization cannot make a dirty milk clean or guarantee that a milk is properly collected. The importance of inspection of the raw milk and its source cannot be over-stressed, but, granted complete inspection, the public cannot be safeguarded unless the milk is properly pasteurized. The necessity for general pasteurization is amply demonstrated every year in our high death-rates from diarrhoea and enteritis, in our milk-borne typhoid epidemics or septic sore throat epidemics, the increasing cases of undulant fever, and our cripples from bovine tuberculosis. Our objective must be safe, clean, wholesome milk. Proper pasteurization is the only means of assuring protection against milk-borne disease.

**Resolution passed at a meeting of the Executive Committee held in Toronto in June 1935, and published in the Canadian Public Health Journal, 1938, **29**: 309.*

# Consumption of Milk in Canada

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THE average daily consumption of fluid milk per person in Canada varies considerably between different cities. Information obtained from representative samples of city households of different sizes, different incomes and of different national types indicates that the range between cities is about 0.55 to 0.75 of a pint per person per day.

Consumption of fluid milk in villages has not been adequately studied but from what limited information is available it appears that the average per caput consumption is fairly similar to that in nearby cities but that the variation between villages may be somewhat greater than between cities.

The per caput consumption of fluid milk in rural areas in Canada is considerably higher than that in cities and villages, averaging well above one pint per person per day in farm households and about one pint per person per day in other rural households.

## MILK CONSUMPTION IN CITIES

Studies of milk consumption on which the above statements are based have been made in recent years by the Economics Division of the Marketing Service of the Dominion Department of Agriculture. In connection with studies of family living expenditures in Canada information has also been obtained on milk consumption by the Dominion Bureau of Statistics.

According to statements made by 3684 housewives representing high, medium and low income families of all occupations and nationalities who were personally interviewed by representatives of the Dominion Department of

TABLE 1
DAILY PER CAPUT CONSUMPTION OF FLUID MILK IN FOUR CANADIAN CITIES, 1935[1]

| Locality | Number of households | Number of persons | Consumption as reported by housewives |
|---|---|---|---|
| *Cities* | | | pints |
| Oshawa | 816 | 3365 | 0.71 |
| Quebec City (French and English) | 790 | 4686 | 0.68 |
| Calgary | 996 | 3995 | 0.74 |
| Vancouver | 1082 | 4250 | 0.65 |
| Total or average | 3684 | 16,296 | 0.70[2] |

[1]From Publication 608—An Economic Study of the Consumption of Milk and Cream in Certain Urban and Rural Districts of Canada by W. C. Hopper and G. P. Boucher, and Publication 678—An Economic Study of the Consumption of Milk and Cream in Vancouver by Charlotte I. Johnston and W. C. Hopper. Dominion Department of Agriculture, Ottawa.

[2]Checks which have been made on surveys of this kind indicate that on the average housewives tend to overstate their consumption of milk by possibly 10 per cent and in some cases as high as 15 per cent. If the reported consumption were adjusted for this overestimation the average daily consumption would be closer to six-tenths of a pint.

Agriculture in 1936, the average daily consumption of fluid milk per person in four cities of Canada was seven-tenths of a pint (table 1). This figure does not include milk consumed in any purchased product such as canned milk, cheese, bread, ice cream, etc., but only the fluid milk purchased or brought into the home in that form. Approximately 62 per cent of the fluid milk used in these city households was used as a beverage.

In a study of the purchases of food by wage-earner families in twelve representative cities of Canada by the Dominion Bureau of Statistics the actual purchases of fluid milk each day during one week between October 3 and November 10, 1938, were recorded by housewives in 1569 families. The results of this study show that the average consumption of fluid milk ranged from 0.53 of a pint per person per day amongst French-speaking families in Montreal to 0.74 of a pint amongst families other than those of British origin in the city of Winnipeg (table 2). The daily per caput consumption in the cities of Halifax, Saint John and Quebec was less than six-tenths of a pint while in Ottawa, London and Saskatoon the average was more than seven-tenths of a pint.

TABLE 2

DAILY PER CAPUT PURCHASES OF FLUID MILK BY 1569 CITY WAGE-EARNER FAMILIES DURING THE PERIOD FROM OCTOBER 3 TO NOVEMBER 10, 1938, IN VARIOUS CITIES OF CANADA[1]

| City | Number of families | Actual per caput purchases of fluid milk per day |
|---|---|---|
| | | pints |
| Charlottetown | 62 | .65 |
| Halifax | 89 | .56 |
| Saint John | 86 | .57 |
| Quebec—French-speaking | 86 | .54 |
| Montreal—French-speaking | 130 | .53 |
| English-speaking | 75 | .64 |
| Other | 42 | .61 |
| Ottawa | 106 | .71 |
| Toronto | 163 | .64 |
| London | 80 | .71 |
| Winnipeg—British | 188 | .66 |
| Other | 43 | .74 |
| Saskatoon | 126 | .71 |
| Edmonton | 107 | .67 |
| Vancouver | 186 | .68 |

[1]Calculated from Dominion Bureau of Statistics mimeograph report on "Family Living Expenditures in Canada—Canadian Urban Wage-earner Family Purchases of Foods" (1939). (Price 15 cents.)

## MILK CONSUMPTION IN VILLAGES

No adequate data are available on the consumption of milk in towns and villages of Canada. Information was collected by personal interviews from housewives representing 251 families in three villages in 1935. One of these villages is in Ontario, one in Quebec and one in Alberta. In two of these places the per caput consumption of milk was very similar to that in nearby cities,

but in St. Romuald the reported consumption was only 0.40 of a pint per day (table 3). This Quebec village, at the time of the survey, had many unemployed families and the reported consumption is probably not representative of villages in the province of Quebec as a whole. Further studies of milk consumption in towns and villages in Canada would be desirable.

TABLE 3

DAILY PER CAPUT CONSUMPTION OF FLUID MILK IN THREE CANADIAN VILLAGES, 1935[1]

| Locality | Number of households | Number of persons | Consumption as reported by housewives |
|---|---|---|---|
| *Villages* | | | pints |
| Uxbridge, Ontario... | 102 | 345 | 0.73 |
| St. Romuald, Quebec | 48 | 287 | 0.40 |
| Claresholm, Alberta. | 101 | 432 | 0.70 |
| Total or average..... | 251 | 1064 | 0.63 |

[1]From Publication 608, Dominion Department of Agriculture, Ottawa.

## MILK CONSUMPTION IN RURAL AREAS

With the co-operation of Home Economic Extension Workers in the various provinces a study was made in 1937 of the consumption of milk and other dairy products in rural households in the various provinces of Canada. Questionnaires were distributed by these provincial workers to representative rural homes and after they were completed they were returned by mail. The daily average per caput consumption of fluid milk of all kinds in the 823 farm households from which information was obtained was 1.37 pints. This was made up of 1.09 pints of whole milk, 0.20 of a pint of skim milk and 0.08 of a pint of buttermilk (table 4). There was considerable variation between provinces but the average consumption of all fluid milk in farm households for every province was greater than one pint per person per day.

In rural households other than those of farmers the average per caput consumption of all fluid milk was 1.07 pints per day (table 5). In three provinces, namely, Quebec, Ontario and British Columbia, the average was less than one pint per person per day but in all other provinces the average was more than this quantity.

Although the average consumption of milk in rural Canadian households was greater than one pint per person per day, in 28 per cent of the farm households the average per caput consumption was less than one pint daily and 5 per cent used less than one one-half a pint daily. In rural households, other than farmers, 50 per cent of the households had a per caput consumption of less than one pint per day and 12 per cent used less than one-half a pint per person daily.

This survey also showed that approximately one-third of the fluid milk brought into rural homes is used in cooking.

TABLE 4

DAILY CONSUMPTION OF WHOLE AND SKIM MILK AND BUTTERMILK IN FARM HOUSEHOLDS IN VARIOUS PROVINCES OF CANADA, 1937[1]

| Province | Number of households | Total number of persons | Consumption per person | | | |
|---|---|---|---|---|---|---|
| | | | Whole milk | Skim milk | Butter-milk | All[2] milk |
| | | | pints | pints | pints | pints |
| Prince Edward Island | 82 | 528 | 1.28 | .22 | .06 | 1.56 |
| Nova Scotia | 124 | 742 | 1.18 | .22 | .04 | 1.44 |
| New Brunswick | 129 | 829 | .90 | .37 | .27 | 1.54 |
| Quebec | 792 | 5755 | 1.00 | .09 | .05 | 1.14 |
| Ontario[3] | 225 | 1067 | 1.09 | .10 | .06 | 1.25 |
| Manitoba | 122 | 711 | .80 | .52 | .12 | 1.44 |
| Saskatchewan | 298 | 1670 | 1.46 | .42 | .13 | 2.01 |
| Alberta | 17 | 108 | 1.13 | .18 | .06 | 1.37 |
| British Columbia | 34 | 190 | 1.31 | .26 | .06 | 1.63 |
| Total or average | 1823 | 11,600 | 1.09 | .20 | .08 | 1.37 |

[1]From mimeograph report, "Consumption of Dairy Products in Rural Canadian Homes," by W. C. Hopper and P. H. Casselman.

[2]All milk does not include condensed, evaporated or powdered milk.

[3]In connection with a study of the dairy farm management and the cost of milk production in Ontario, information was obtained on the consumption of milk in 506 households on dairy farms. This group of farms included those selling milk for cheese, butter and manufactured milk products, as well as farms selling milk for consumption in fluid form. These households included 2405 persons of whom 620 were under 14 years of age. The daily per caput consumption of whole milk was 1.25 pints. Only 6 of the 506 households used skim milk in the home. The consumption of skim milk per household was only 0.05 of a pint. One household used skim milk only.

TABLE 5

DAILY CONSUMPTION OF WHOLE AND SKIM MILK AND BUTTERMILK IN RURAL HOUSEHOLDS OTHER THAN THOSE OF FARMERS IN VARIOUS PROVINCES OF CANADA, 1937

| Province | Number of households | Total number of persons | Consumption per person | | | |
|---|---|---|---|---|---|---|
| | | | Whole milk | Skim milk | Butter-milk | All[1] milk |
| | | | pints | pints | pints | pints |
| Prince Edward Island | 12 | 72 | 1.14 | .29 | .19 | 1.62 |
| Nova Scotia | 72 | 396 | 1.18 | .11 | .10 | 1.39 |
| New Brunswick | 62 | 377 | .84 | .21 | .15 | 1.20 |
| Quebec | 350 | 2042 | .87 | .04 | .03 | .94 |
| Ontario | 140 | 561 | .84 | .02 | .06 | .92 |
| Manitoba | 94 | 452 | .89 | .13 | .04 | 1.06 |
| Saskatchewan | 62 | 333 | 1.12 | .19 | .09 | 1.40 |
| Alberta | — | — | — | — | — | — |
| British Columbia | 22 | 107 | .77 | .07 | .05 | .89 |
| Total or average | 814 | 4340 | .92 | .09 | .06 | 1.07 |

[1]All milk does not include condensed, evaporated or powdered milk.

## RELATION OF FAMILY INCOME TO MILK CONSUMPTION

Differences in food-consuming habits of different nationalities appear to affect the amount of milk used in the home. In the surveys made by the Dominion Department of Agriculture in Canadian cities already referred to, French-Canadians had a lower per caput consumption than those of other racial groups, as did also Jews, Italians, and Orientals.

If there was a greater appreciation of the value of milk in the diet the average consumption of this essential food would undoubtedly be higher, but

probably the most important factor determining the consumption of milk in urban homes is the family income (table 6).

TABLE 6
DAILY PER CAPUT CONSUMPTION OF MILK AS RELATED TO FAMILY INCOME, 3207 RURAL AND URBAN FAMILIES[1] IN THE PROVINCES OF QUEBEC, ONTARIO, AND ALBERTA, 1935

| Family income | Number of families | Number of persons | Per caput consumption per day reported by housewives |
|---|---|---|---|
| | | | pints |
| On relief | 189 | 921 | 0.54 |
| Under $1,000 | 1263 | 5868 | 0.69 |
| $1,000—$2,000 | 1060 | 4978 | 0.76 |
| $2,000—$4,000 | 544 | 2486 | 0.81 |
| $4,000 and over | 151 | 826 | 0.95 |

[1]2602 were in cities.

Low income families had a much smaller average consumption of milk than families with high incomes. If the families with incomes below $4,000 a year were to have the same amount of fluid milk as the families with incomes of $4,000 a year or more, it would require an increase in the production of fluid milk in Canada of about one billion pounds per year or in other words an amount equivalent to the production of more than 200,000 dairy cows giving 5000 pounds each per year. The value of this increased quantity of milk to Canadian dairymen at $1.50 per hundred pounds would be $15,000,000 annually.

## THE CONSUMPTION OF MILK BY ADULTS

Only 23 per cent of the adults (over 16 years of age) in 3207 representative Canadian households (2602 of which were in cities) drank any milk (table 7). Many of these adults were young men and women who had not attained their full growth. The percentage of adults drinking milk varied with the family income. Only 12 per cent of the adults in families on relief drank milk. In families with incomes of less than $1,000 a year the average percentage of adults drinking milk was 21, while in families with incomes of $4,000 a year or more 32 per cent of the adults drank milk. Milk used in other beverages such as coffee and tea, milk used on cereals and in cooked dishes is not included.

TABLE 7
PROPORTION OF ADULTS (OVER 16 YEARS OF AGE) DRINKING MILK IN 3207 CANADIAN FAMILIES IN DIFFERENT INCOME GROUPS, 1935[1]

| Family income | Number of families | Proportion of adults drinking milk |
|---|---|---|
| | | Per cent |
| On relief | 189 | 12 |
| Under $1,000 | 1263 | 21 |
| $1,000—$2,000 | 1060 | 23 |
| $2,000—$4,000 | 544 | 24 |
| $4,000 and over | 151 | 32 |
| Total and average | 3207 | 23 |

[1]From Publication 608, Dominion Department of Agriculture, Ottawa.

## CONSUMPTION OF MILK BY CHILDREN

Because of the importance of milk in the diet of children a special effort was made in the surveys conducted by the Dominion Department of Agriculture to learn the amount of milk used as a beverage by boys and girls of different ages in Canadian cities. The facts revealed in table 8 are significant. The figures in this table were compiled from statements made during personal interviews in 3684 city households. The first fact of importance shown by the table is that more than 20 per cent of the children (16 years of age and under) in the households interviewed in Oshawa and Quebec City drank no milk. In Calgary 16 per cent and in Vancouver 14 per cent of the children did not use milk as a beverage. The proportion of children not drinking milk

TABLE 8

RELATION BETWEEN FAMILY INCOME AND NON-CONSUMPTION OF MILK AS A BEVERAGE BY 5040 CHILDREN OF VARIOUS AGE GROUPS IN 3684 FAMILES IN THE CITIES OF OSHAWA, QUEBEC, CALGARY, AND VANCOUVER, 1935[1]

| Family income | Total children | Percentage of children not drinking milk | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Boys | | | Total for boys | Girls | | | Total for girls | Total for all children |
| | | Under 6 years | 6-12 years | 13-16 years | | Under 6 years | 6-12 years | 13-16 years | | |
| | | % | % | % | % | % | % | % | % | % |
| *City of Oshawa* | | | | | | | | | | |
| On relief | 72 | 20 | 15 | 33 | 21 | 8 | 25 | 13 | 15 | 18 |
| Under $1,000 | 458 | 17 | 27 | 47 | 27 | 11 | 31 | 44 | 27 | 27 |
| $1,000—$2,000 | 397 | 12 | 25 | 24 | 19 | 5 | 21 | 30 | 17 | 18 |
| $2,000—$4,000[2] | 100 | 11 | 14 | 17 | 14 | 6 | 35 | 11 | 20 | 16 |
| Total | 1027 | 14 | 23 | 34 | 22 | 7 | 26 | 34 | 21 | 21 |
| *City of Quebec* | | | | | | | | | | |
| On relief | 142 | 22 | 42 | 91 | 41 | 32 | 50 | 69 | 44 | 43 |
| Under $1,000 | 631 | 15 | 38 | 48 | 31 | 17 | 44 | 52 | 34 | 32 |
| $1,000—$2,000 | 611 | 8 | 23 | 20 | 16 | 10 | 28 | 34 | 24 | 20 |
| $2,000—$4,000 | 280 | 2 | 3 | 23 | 6 | 6 | 9 | 40 | 14 | 9 |
| $4,000 and over | 151 | 10 | 6 | 5 | 7 | 7 | 10 | 15 | 11 | 8 |
| Total | 1815 | 11 | 24 | 33 | 20 | 15 | 29 | 41 | 26 | 23 |
| *City of Calgary* | | | | | | | | | | |
| On relief | 125 | 19 | 38 | 42 | 32 | 36 | 34 | 18 | 30 | 31 |
| Under $1,000 | 273 | 14 | 27 | 42 | 19 | 12 | 27 | 61 | 31 | 24 |
| $1,000—$2,000 | 393 | 3 | 8 | 25 | 9 | 4 | 13 | 32 | 17 | 12 |
| $2,000—$4,000[3] | 229 | 6 | 8 | 20 | 10 | — | 11 | 19 | 10 | 10 |
| Total | 1020 | 8 | 18 | 30 | 14 | 9 | 18 | 33 | 20 | 16 |
| *City of Vancouver* | | | | | | | | | | |
| On relief | 127 | 14 | 18 | 38 | 19 | 4 | 12 | 56 | 16 | 17 |
| Under $1,000 | 453 | 6 | 24 | 22 | 17 | 7 | 29 | 46 | 26 | 22 |
| $1,000—$2,000 | 464 | — | 6 | 14 | 6 | 3 | 6 | 25 | 9 | 8 |
| $2,000—$3,000 | 104 | 13 | 17 | 22 | 18 | — | 5 | 25 | 11 | 14 |
| $3,000—$4,000[4] | 37 | — | — | — | — | — | — | 11 | 5 | 3 |
| Total | 1185 | 5 | 14 | 18 | 12 | 5 | 15 | 34 | 17 | 14 |

[1]From Publication 608, Dominion Department of Agriculture, Ottawa.
[2]In the income group, $4,000 and over, there were 30 children all consuming milk.
[3]In the income group, $4,000 and over, there were 47 children all consuming milk.
[4]In the income group, $4,000 and over, there were 16 children all consuming milk.

varied with age and family income. In all cities the larger the family income the smaller the proportion of children not using milk as a beverage. The younger the children the larger the proportion drinking milk.

Another important fact is that many teen-age children in cities do not drink milk. Approximately one-third of the children in the age group of 13 to 16 years on the average drink no milk. In low income families (less than $1,000 a year) from 40 to 60 per cent in this age group drink no milk. Even amongst the high family income groups many of the children between 13 and 16 years of age drink no milk.

In Calgary and Quebec City the children in the families on relief had less milk to drink than those in other family income groups. In the city of Quebec, 22 per cent of the boys and 32 per cent of the girls under 6 years of age in relief families who were interviewed drank no milk, and the proportion not drinking milk in relief families was higher where the children were older.

Not only was there a smaller proportion of children drinking milk in the low income families, but in such families the amount consumed per child was less than in families with high incomes. The average amount of fluid milk consumed by children drinking milk ranged from about one pint per day in low income families to one and one-half pints per day in high income families.

In the main there was little difference between the proportion of boys and girls not drinking milk but in three of the four cities mentioned there was a slightly larger percentage of girls than of boys not using milk as a beverage.

This paper covers only a few of the more outstanding facts obtained by studies which have been made in Canada on milk consumption. In the bulletins and reports mentioned in the footnotes to tables, however, further information may be obtained on this important subject.

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## THE CANADIAN MEDICAL ASSOCIATION AND COMPULSORY PASTEURIZATION*

WHEREAS raw milk may be the means of transmitting various types of serious infectious diseases such as bovine tuberculosis, typhoid fever, undulant fever, scarlet fever, diphtheria, septic sore throat, etc., and is a major factor in high infant mortality; and

WHEREAS it has come to our attention that there are many areas in Canada where raw milk is still distributed and sold;

BE IT RESOLVED that this Association go on record as endorsing the compulsory pasteurization of all milk offered for sale.

**Resolution passed at the annual meeting held in Ottawa, June, 1937, and published in the Canadian Public Health Journal, 1938, **29**: 269.*

# Milk Consumption in the Vancouver Metropolitan Area

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SINCE the outbreak of the war, considerable interest has been manifested in the nutritional state of the Canadian people. Professional and lay organizations have co-operated to outline educational programs directed toward a better understanding of the fundamentals of nutrition and the relation of nutrition to health. In the past many morbid conditions, at times epidemic in character, have been associated with faulty dietaries and, from a preventive angle, the problem of nutrition is one which should engage every active health department.

While not complete in every respect, milk is a basic food and, together with cereals and fruits, forms the nucleus of our national dietary. A populace whose basic milk requirements are not satisfied will most assuredly deteriorate, especially in the physical development of its young; the health and well-being of its adult members will not be maintained, with concomitant loss of vitality so necessary for the energetic prosecution of the war.

In the last year it was suggested that the consumption of milk in the Vancouver Metropolitan Area was low. By comparison with the per caput consumption (1) in Canadian cities of corresponding size, such unofficial figures as were available locally tended to reflect a serious situation.

The Canadian Council of Nutrition (2) has expressed minimal amounts of food constituents which are necessary for health and efficiency. Minimal daily milk requirements are outlined, according to age, as follows:

CONSUMPTION OF MILK

| | | |
|---|---|---|
| Children: | To end of 6 months of age | 1.5 pints daily |
| | From end of 6 months to end of 1st year | 1 quart daily |
| | From end of 1st year to end of 10th year | 1 pint daily |
| | From end of 10th year to end of 18th year | 1.5 pints daily |
| Adults: | Men and women, except as noted below | 0.5 pints daily |
| | Pregnant and nursing mothers | 1.5 pints daily |

Infants seven months to two years were included as one group in the local survey, with requirements of one quart daily; slightly different from the above, but not sufficient to influence the results markedly. Children three to ten years were included in one group with requirements of one pint daily. The local questionnaire did not specify pregnancy or nursing.

Accordingly, with these authoritative figures as a standard, the Metropolitan Health Committee decided, not only to determine the actual per caput consumption of milk in Vancouver, but also to assess consumption figures in relation to the standard minimum.

Questionnaires regarding the total daily family consumption of milk were distributed through the medium of school children to the homes. The size of families, according to age, and the total daily consumption of milk of all kinds, including canned, served not only to assess the returns on a "family unit" basis but also to determine the "family unit" consumption in relation to standard minimum requirements. Duplication of returns was avoided and the questionnaires were filed according to respective school and health-unit areas. It may be recalled that the Metropolitan Area is composed of six local health units, and all units with the exception of one participated in this survey.

It was felt that this method of determining per caput consumption was essentially fair, representing a cross-section of the whole community including those families with at least one child of school age.

## FINDINGS

Questionnaires regarding family consumption of all types of milk were distributed from eighty-seven schools, including high schools and annexes in Vancouver, the City of North Vancouver, the Municipalities of North and West Vancouver, and the Municipality of Richmond. The Nursing Division of the Metropolitan Health Committee supervised the distribution and collection of questionnaires and assisted in the final tabulation.

A total of 25,170 questionnaires were sent out and 17,825 were returned, of which 16,260 were suitably answered. A total of 37,873 adults and 34,630 children were distributed among the 16,260 families, giving an average of 4.5 persons per family. The total population of the Area surveyed is approximately 300,000.

The average per caput consumption of milk was 0.83 pints daily. This figure fell short by 6 per cent of the minimum standards as suggested by the Canadian Council of Nutrition, with local amendments. Forty-six per cent of the families were found to be consuming less than minimum requirements. There was considerable variation according to the size of families and the following table reflects this situation.

| Children in Families | No. of Families | Relation of Family Milk Consumption to Minimum (Percentage of Families) | | |
|---|---|---|---|---|
| | | Under Minimum | Minimum | Over Minimum |
| 1 and 2 children | 11,515 | 37 | 17 | 46 |
| 3 and 4 children | 3,801 | 68 | 8 | 24 |
| 5 or more children | 944 | 88 | 3 | 9 |

This survey is based upon minimal milk requirements and it is not suggested that this standard approaches perfection. Optimal conditions might be found, as suggested by Rosenau (4), when every child receives at least one quart of milk a day and every adult not less than one pint. Although the milk consumption of the Area surveyed fell short by 6 per cent of minimal standards, the consumption, according to optimal standards, fell short by approximately 44 per cent.

Also it must be realized that the present per caput consumption of 0.83 pints daily represents merely an average and ignores the fact that a large proportion of the populace are not receiving anything like this amount. Replies, 3,373 in number, from 17 school areas comprising one health unit, showed that not one school area approached minimum requirements.

Factors determining the family use of milk were:

(*a*) *Economic level of the area.* The higher the economic level the more milk used and also fewer children in proportion to adults.

(*b*) *Rural versus urban.* More milk was used in rural and semi-rural than in urban areas.

(*c*) *Racial population.* There were proportionately more children among the Oriental population, but the consumption of milk was not increased accordingly. Orientals are poor milk consumers.

(*d*) *Attitude.* Thirty-eight per cent of families who were satisfied with their daily quota were actually consuming less than minimum requirements. On the other hand, 24 per cent of the families who considered their daily consumption insufficient were using more than required by minimum standards. Ninety-five per cent of families who claimed they were not using enough milk excused themselves on economic grounds.

(*e*) Of interest is the fact that 74 per cent of the families used pasteurized or canned milk only while 20 per cent consumed raw milk solely. But 6 per cent used both raw and pasteurized milk. Only one area, largely rural, consumed more raw than pasteurized milk.

## DISCUSSION AND RECOMMENDATIONS

Although the per caput consumption of milk in Vancouver may be considered but 6 per cent short of minimum requirements, the need for increased consumption by many families in the community is apparent. Why do people not use more milk? The main reason is presumably the cost, although milk is not an expensive commodity when its value as a nearly complete food is assessed against other types of food. There is also evidence that many people do not know the quantities of milk necessary to maintain themselves and their children in good health.

Steps are being taken to publicize milk and to inform every person of his daily requirement. Our Committee has met with representatives of local milk distributors with the purpose of furthering local consumption by joint effort.

The advantages of skim milk are not appreciated. Being essentially as nutritious as whole milk, more could be used with advantage, especially by those who find the cost of whole milk prohibitive. There are certain dairies in Vancouver and district which sell skim milk and in some cases deliveries are made. Skim milk sells for approximately half the price of whole milk. However, it is doubtful if widespread distribution of skim milk is practical, involving as it must a considerable change in milk economy.

Approximately 35 per cent of the schools in Vancouver have some system of milk distribution to children. This is accomplished through cafeterias in high schools and the distribution in others at cost for those who can pay for it.

In some cases funds for this service are provided by welfare agencies, including parent-teacher groups. The need for this type of service varies greatly. Many areas would benefit by this procedure, in others the need is not so great. However, it would be difficult, in a general scheme of distribution, not to include all schools. To date such action has not been taken.

It would seem reasonable to advocate the more general use of milk products, including cheese. Canadian cheese is a much cheaper source of calcium than milk, and contains by weight about eight times the amount of calcium found in milk, as well as iron, protein, fat and many of the essential vitamins. The community, especially the adolescent and adult population, would benefit greatly by increased consumption of cheese.

In advocating the more extensive use of milk and milk products it is recommended that pasteurized milk only be used. Health hazards inherent in raw milk are many, not the least of which is the widespread dissemination of brucellosis in the Vancouver Area (4). Until "universal pasteurization" is introduced, milk is essentially a dangerous commodity.

Undue emphasis should not be placed on milk solely. It should, however, be a spark plug in any measure taken to improve the total nutritional state, which is dependent upon many factors—diet in its entirety, availability, preferences, environment, ignorance and apathy. There are many interested organizations, both professional and lay, who are in a position to educate the public in these matters and it is of interest that The Health League of Canada and its subsidiaries are making available nutritional classes for the public in the larger cities; classes not to demonstrate cooking only but mainly to explain the fundamentals of nutrition and how best the dollar may serve to purchase and prepare dietary essentials. The Greater Vancouver Health League, in co-operation with the Department of University Extension, University of British Columbia, opened eight such classes in Vancouver recently, but public interest created the demand for more and four additional classes have since been formed. The classes are held once weekly and approximately 350 members have enrolled. It is planned to have each class run for eight weeks, and local dietitians have volunteered to prepare a working manual and conduct the courses.

The Canadian Medical Association, with the financial assistance of the Canadian Life Insurance Officers' Association and the Canadian Red Cross Society, has recently published an attractive booklet, "Food for Health—In Peace and War." This booklet contains pertinent information regarding diet, essential foods, daily requirements and approximate costs. Widespread distribution of such information from authoritative sources, with ethical advertising as evidenced by groups such as The Milk Foundation of Toronto, are measures calculated to bring home to the people of Canada that improved health through nutrition is available to all.

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# An Educational Program to Raise Nutrition Levels Through Increased Milk Consumption

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FIGURES for milk consumption in the City of Toronto indicate that the average amount of milk used amounts to approximately two-thirds of a pint per person per day. Nutritionists recommend, as a minimum amount, one and one-half pints daily for a child and one-half to one pint daily for an adult. From these two facts, it will be seen that, for adequate nutrition, the milk consumption in Greater Toronto should be practically doubled.

Surveys in other parts of Canada tell much the same story. Dominion Government figures published in 1938 show the average per caput consumption of milk in urban and rural communities to be 0.71 pint. But this figure, low as it is, does not tell the complete story. A very high percentage of adults did not drink milk at all and 21 per cent of children under sixteen years of age who were studied drank no milk.

There are two main reasons for this inadequate consumption—lack of knowledge concerning the value of milk and lack of money to purchase adequate amounts.

It seems logical, in the face of these facts, that an educational program designed to increase public knowledge of the food value of milk would be the first step in raising to more desirable levels the consumption of this food essential. The Milk Foundation of Toronto was formed for such a purpose. This organization is now in its fourth year, is conducted on a strictly non-commercial, non-profit basis, and is maintained by members from the local dairy industry—both producers and distributors. The aim of its ever-expanding program of health education is to point out the place of milk in the well-balanced diet and to emphasize the fact that, from the standpoint of food essentials, milk is the most economical food that can be bought.

The methods employed by the Foundation in carrying out its educational program are varied, so that they may appeal to all ages, interests and incomes. Those which have been found most useful are described here, in the hope that they may be valuable in other centres where the problem of raising nutrition levels is receiving deserved attention.

## Newspaper Advertising

A campaign of newspaper advertising featuring authoritative statements about milk is conducted continuously. The theme is changed from time to time, but the health angle is the basis for all other appeals—economy, patriotism, appearance, physical fitness, athletic prowess, etc. Statements made and figures

given in advertising copy—or through any other medium—are carefully checked and rechecked to permit no overstatement or inaccuracy. The story is told over and over again, with a new theme or a new illustration but always with the same message, "Drink More Milk"; and over a period of time this message will impress its significance on the public confidence.

Supplementing this daily reminder are streamers and display cards, supplied by The Milk Foundation to restaurants, milk bars, fountains, etc., which are served by the distributor members. These keep calling attention to milk as a refresher and as an important item in the luncheon or dinner menu.

## EDUCATIONAL LITERATURE

Educational literature of widely varying character has been and is being constantly prepared and circulated. Some of it gives general information and is distributed widely through such agencies as salesmen of member dairies, teachers and public health workers. One example of this kind of material is a small leaflet entitled "For Health All the Family Needs Milk". This outlines briefly the foods needed for good health, with special emphasis on milk as the leader of this group. It points out the relationship of milk to economy, to appearance, strength and vigour, and in a concise statement of facts concerning the composition of milk shows why this food is of major importance in these respects. Between 90,000 and 100,000 copies of this leaflet have reached Toronto consumers through various channels.

Other pieces of literature exert a more specific appeal, e.g. "The Hollywood 14-Day Diet", consisting of information about foods and food values, some common-sense rules for weight control, and actual menus with their calorie content. This was released two and one-half years ago and more than 75,000 booklets have been distributed, with requests still being received.

A booklet entitled "Why Athletes Train on Milk" had a wide circulation among boys and young men. A comparatively recent one, "A Perfect Picture", contains a special appeal to teen-age girls. "How to Select Foods for Your Family" and "Safe Meals That Save Money" are titles which attract mothers and other homemakers; this material has also been supplied in considerable numbers to nutrition and home-economics classes.

Two recent publications stress the importance of proper nutrition in the growth and maintenance of strong, healthy teeth. One is designed for general distribution, the other for children six years of age and over.

"The Never Failing Stream" and "Let's Travel the Milky Way" tell the complete story of milk from the farm to the family table. The former is designed for upper grade students and contains considerable detail; the latter is shorter and simpler, and suitable for lower grades. Both are clearly illustrated with authentic photographs.

"Geraldine", a delightful story for little children, and an accompanying supplement which can be coloured and made into individual books by the children themselves, have been exceedingly popular with teachers.

Posters and charts also help to keep the story of milk fresh in the minds of the public and are frequently used by teachers and nutrition workers to illustrate graphically the lessons being taught.

### "THE MILKY WAY"

A moving picture, "The Milky Way", in technicolor and with sound, has been extremely popular and in almost constant demand since its release, early in 1940. It was produced expressly for The Milk Foundation and tells the complete story of milk from grass to table, emphasizing the careful treatment and rigid inspection which fresh milk undergoes at the dairy farms and in the city milk plants. The necessity for scientifically controlled production and selection of dairy rations is pointed out as an essential basis for the production of good milk. This application of sound nutrition principles to the maintenance of health and efficiency in animals serves as a fine example in the teaching of human nutrition. The insistence on absolute cleanliness and the importance of pasteurization are stressed and audiences are impressed with the exacting methods used to safeguard this vital food product.

The Milk Foundation supplies film, projector, screen and operator and has shown the picture to all types of audience, including thousands of children in the schools. For the great majority of adult audiences the showing is accompanied by a talk along lines best calculated to interest the particular group, but always based on the original theme, "Drink More Milk". In the schools, the film supplements the class work in health education, home economics, science and agriculture and has been highly praised by teachers.

### LECTURES AND FOOD DEMONSTRATIONS

Lectures and food demonstrations are important features of the program and offer opportunities for direct contact with both small and large groups of people—women, men and mixed audiences. In such circumstances, the story of milk and its importance in the dietary scheme may be more personally and more vividly presented. Lectures are on nutrition and related subjects, the actual topic often being requested by the group itself.

Food demonstrations illustrate new and varied ways of using milk in everyday meals and in all manner of special-occasion menus and other unusual circumstances. The food demonstrator carries portable equipment and supplies with her and supplements the demonstration with a talk and printed recipes or pamphlets. As a result of such programs as these, many personal problems are brought to the speaker, nutrition questions are discussed and difficulties of meal planning and preparation ironed out. Requests for additional literature or recipes are a further indication of the interest stimulated.

### WORK WITH SCHOOLS

Work with schools has been mentioned incidentally under other headings. It includes the preparation and circulation of literature, projects, posters and

charts which teach the health lesson and illustrate the value of milk in good nutrition. Sample material is sent to teachers and additional copies are supplied on request.

An indication of the enthusiasm with which this material is received is shown by some figures for distribution up to the end of February 1941:

| *Title* | *Approximate Number* |
|---|---|
| Geraldine | 1,400 |
| Geraldine Supplement | 16,400 |
| My Growth Record | 18,700 |
| Best Foods for Health (2-6) | 4,800 |
| Best Foods for Health (6-16) | 16,550 |
| Milk From Many Animals | 7,100 |
| The Talking Tooth | 12,900 |
| Good Teeth—A Precious Possession | 6,700 |
| A Perfect Picture | 3,600 |
| How to Select Foods for Your Family | 9,300 |
| Safe Meals That Save Money | 6,300 |
| For Health All the Family Needs Milk | 4,300 |
| The Hollywood Diet | 800 |
| The Never Failing Stream | 2,300 |
| Let's Travel the Milky Way | 8,600 |

The place of the moving picture in the school program has already been outlined. It is the intention of The Milk Foundation to produce additional films from time to time, dealing with nutrition and its relation to optimum growth and abundant health.

Two poster contests have been conducted by The Milk Foundation, in which prizes were awarded for the best "Milk for Health" posters produced by public school children and similar prizes for the best ones submitted by high school students. The interest and co-operation displayed in this project were extremely gratifying. These posters, after being judged by competent artists and teachers, were on display in a local department store where they were viewed by large numbers of people. Since then, groups of them have been loaned to schools to assist in health and art instruction.

A display card, to be used as loan material, shows the composition of a quart of milk. Glass phials mounted on the card contain exact amounts of the various food constituents which go to make up a quart of milk: the protein, butterfat, lactose, calcium and phosphorus are all there and provide the teacher with visible evidence of the facts being taught.

Other material of a type to appeal to children in each grade is being prepared constantly and the willing co-operation of teachers is of immense value in determining what is most useful.

## CO-OPERATION WITH PROFESSIONAL GROUPS

Co-operation with professional groups (doctors, dentists, nurses, research workers), health and welfare agencies, educational bodies, service clubs and others whose interests lie in raising health standards is an essential and very helpful means of broadening the effectiveness of the work being done and of further inspiring the confidence of the public.

Through displays at their conventions, social workers and dentists have had the opportunity of examining the material which The Milk Foundation can supply to assist them in emphasizing the importance of milk in proper nutrition as applied to their particular fields.

Local and Provincial departments of health have done much to further the aims of the Foundation. At the dental convention, for instance, the local department of health arranged a milk inspection exhibit as part of the general Milk Foundation display and their experts were always on hand to demonstrate the methods used in maintaining high standards of quality and cleanliness for our milk supply and to answer questions along these lines.

Suggestions from the health departments are always most welcome and the Foundation is more than willing to consult with public health or school nurses and to supply them and other workers with any nutrition material which would be useful in their work. The Foundation appreciates, too, the co-operation given by these agencies in advocating more milk for better health.

Advice and support from local and Provincial departments of education add immeasurably to the value of the work being done, for by establishing sound habits of health and good nutrition in today's children, we lay the foundation for a healthy, progressive nation. As part of the general health program being carried out in schools, a knowledge and appreciation of proper nutrition should and do play an important part, and it is one of the major aims of The Milk Foundation to encourage and assist in this field as much as possible.

At present the scope of The Milk Foundation activities is confined largely to Greater Toronto. However, much interest is being shown in other centres, some of which have recently organized their own local Foundations. As this interest continues, it is hoped that Provincial and Dominion organizations will result and a more widespread dissemination of fundamental nutrition principles will be possible.

Keen interest is the common reaction of all types of audience and reflects the general trend of public thought along lines of health and nutrition. The factual information which the Foundation makes available about the composition and importance of milk as a food has dispelled many old superstitions and overcome certain fallacies which, in some cases, stood in the way of adequate and intelligent use of milk. But, more important, the realization of its indispensibility is causing more and more people to check up on their hitherto casual use of milk and to increase their consumption to a more desirable level. The effect of proper diet on morale and mental outlook is of vital interest to a nation at war and Canadians are not slow to appreciate the relationship and to profit by the knowledge which research workers and educational mediums have made available.

Much has been done, but much more remains to be done in this field of public education in food values and proper nutrition. The Milk Foundation in its campaign to increase milk consumption is concentrating on the product stressed by Dr. F. F. Tisdall, Chairman of the Committee on Nutrition of the Canadian Medical Association, in a radio address, when he stated: "Of all foods, milk is the most valuable."

# The Production of Clean Milk

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BY "clean" milk is generally understood a product free from extraneous matter, such as manure and dust, blood, and an undue number of leucocytes and bacteria.

The term is, in reality, none too satisfactory in that it fails to distinguish between an initially dirty milk, and a milk, which, though produced under satisfactory conditions, may contain large numbers of bacteria as the result of inadequate cooling.

In this necessarily brief article the object will be to outline as concisely as possible the minimum of practical measures which must be adopted if a milk free from both gross impurities and bacterial contamination is to be produced, handled and delivered to the dairy plant, there to be pasteurized and made safe for human consumption.

It is quite evident that in nature's scheme for the nourishment of the young milk was not intended to see the light of day, and in the natural method of nourishment there is little possibility of contamination from external sources. As the artificial process of drawing is resorted to, however, a whole set of conditions entirely new has to be contended with. The milk then comes in contact with the air and with other such sources of secondary bacteriological contamination as dirt and manure on the exterior of the cow's udder, teats and coat, splashings from the floor during urination and defaecation of the cow, the hands and at times the cough-spray of the milker, and the utensils such as pails, milking machines, strainers, coolers, etc.

The reduction of contamination from these outside sources, as well as from the cow herself, forms one of the important problems of the milk sanitarian and an approach to it may appropriately begin with the animal from which the milk is to be drawn.

## The Cow and Preparation for Milking

Granted that after competent examination and tests the cow is free from tuberculosis, contagious abortion, mastitis, Salmonella infections and other less important diseases such as cowpox, suppurative infections of different parts of the body—particularly septic metritis—and diarrhoea due to disease, unsuitable food or other causes, she must still be outwardly prepared for milking. To begin with, her whole body must be clean. This condition can be attained by preventing the animal's gaining access to places in which she is likely to become fouled, and by regular and thorough grooming. She must not be over-crowded, should always be provided with ample and suitable bedding upon a properly constructed

and drained standing, and, particularly before milking, she must not be subjected to dust and chaff from feeding, sweeping or grooming of other animals in the stable.

Her flanks, belly, tail and udder must be kept well clipped, and the bush of the tail not allowed to drag. Shortly before each milking these body-parts and the teats must be gone over carefully with some reliable bactericidal solution such as one containing chlorine.

In addition to the foregoing, the cow should be housed in a well constructed and adequately lighted and drained stable, with reasonably smooth and periodically whitewashed interior surfaces. Swine, goats, poultry, pigeons and other animals and birds should not be kept in direct contact with the stable nor allowed access to it. Each of these conditions plays a part in controlling dust, odour and fly nuisances. With such sanitary surroundings the cow is, from the standpoint of the sanitarian, in a favourable condition for milking.

## THE MILKER AND THE MILKING PROCESS

Just as in the case of the animal about to be milked, so must the milker be free from disease. Strictly speaking, an examination should be made and a morbidity history obtained by an authorized physician from any person engaged or about to be engaged in the production and handling of milk. Should findings show the person to be infected with or be a carrier of the organisms of any of the communicable diseases likely to be transmitted through milk, he should be barred from such employment.

Further, no person suffering from an infected wound, sore or lesion on any part of the body should be permitted to engage in milking.

The healthy milker must also be clean in habits and wear strictly clean clothing. Too often does the milker wear clothing that has done duty for every other work on the farm. It may contain dirt from the hog-pen, the poultry-house, the horse-stable or the swill-barrel, and is entirely unfit to be worn while milking.

The hands above all else must be clean and, after thorough washing, should be rinsed with a bactericidal solution, then dried on a clean towel both immediately before milking and after any interruption during either hand or machine milking operations.

Milk-stools whether of wood or metal must be so constructed as to be easily kept clean, and when not in use must be placed upon hooks or a suitable shelf, and not thrown or kicked into a corner of the stable floor or gutter. The padding of stools with sacking or old carpet must be prohibited as they cannot be kept clean and will contaminate the hands of the milker.

In the case of hand-milking, the pail—and this applies to all milk utensils and equipment—must be smooth, non-absorbent, kept in good repair, and so constructed as to be easily washed and sterilized. An approved type of small-mouth pail, which will decrease the chance of hairs, dust or other undesirable substance falling into the milk, should be used. As it is the first few streams of

milk from each teat which contain most of the bacteria, these should be discarded either into a calf-bucket or other container, but not upon the ground.

As milk drawn from the cow within fifteen days before and five days after calving is apt to contain colostrum, which when consumed tends to produce intestinal disturbances in children, it should not be used. Any abnormal milk noted at the commencement of milking or later while straining, must be kept out of the supply, and away from the dairy animals and milk utensils. As each pail is filled the protected milk must be removed without delay to the milk-house, or, if temporarily more convenient, to a suitable clean room provided for the purpose, and there passed through an approved sterile cloth or disc strainer into an already sterilized milk can. A woven wire cloth strainer must not be used. It should be borne in mind that no amount of straining will make a once-dirty milk clean. This prompt removal of the newly drawn milk from the stable will reduce the chance of contamination and facilitate early cooling.

## COOLING

If it were possible to make definitely sure that no pathogenic organisms had entered the milk up to this time, there would be little reason to direct so much attention to cooling, other than to delay souring. There is, however, no way of knowing this, so that it is of the greatest importance that milk be quickly cooled and kept at a temperature of 50 degrees F. or lower in order that the multiplication of any small numbers of such bacteria shall be checked for at least the first twenty-four hours after production. The process, on the average farm, takes place in the milk house, and may be carried out effectively in several ways.

It is quite impossible in this paper to deal with the various systems in any detail but they may be mentioned. It will be understood, of course, that just as soon as the milk has been strained, the can is placed in the chilling and storing vat in the milk house.

If desired the milk in the can may be stirred once with a sterile metal plunger. This vat may be constructed of concrete or other approved impervious material, insulated, and of a capacity to contain about four gallons of water per gallon of milk to be chilled and stored. The vat must also be provided with a suitable tight cover, and a water inlet and adequate drain.

The chilling process may be hastened by aeration during which the milk is allowed to flow in a thin layer over the surface of a metal container within which is a cooling medium. The aerator, however, constitutes another utensil to clean and sterilize, and where other average cooling facilities are provided, it is not necessary equipment.

Cooling by means of still, uniced water should not be considered as it is quite inefficient except during cold winter months. Cooling in running water will, under favourable circumstances, be found satisfactory during winter months, but seldom is satisfactory during the warmer periods of the year, when ice or mechanical refrigeration should be used. The quantity of ice necessary to cool and hold milk to a required temperature is dependent upon the size of the vat,

the atmospheric temperature, the amount of milk to be cooled, and the extent to which it has been precooled. In areas supplied with electric power, electric refrigeration may be advantageous.

While the cans are still in the vat, the clean lids should be replaced and the cans sealed and made ready for shipment, but not taken from the water until actual shipment is to take place.

## THE MILK HOUSE

This constitutes a most important link in the production and handling of clean milk, and more than can be contained in this article might be submitted concerning it.

It has been rightly said that there are few items upon which more diversity of opinion has been expressed than its location, and many factors should be taken into consideration in this connection. The most important are, however, availability of water, transportation of milk in pails from the barn, and drainage.

Provided that adequate drainage is available, the milk house should be placed as close to the dairy stable as possible. It has been estimated that on a twenty-cow farm with the milk house fifty feet away from the barn, a distance of three hundred miles will have to be walked in one year in carrying the milk to the milk house, and this through all sorts of weather conditions. In such circumstances it is not likely that sufficient care will be given to protecting the milk from possible sources of contamination, and to its prompt cooling and proper storage in the cooling vat.

An attached milk house connected with the barn by a short vestibule with two tight-fitting self-closing doors, and the vestibule provided with abundant cross ventilation, will afford the greatest convenience.

There are those who argue that if the milk house is attached to the barn, the milk will absorb stable odours, but it seems most reasonable that if odours are going to be absorbed the likely time for this to take place is when the milk is passing in a fine stream between the udder and the pail. If the cow-stable is properly constructed, lighted, ventilated and drained, and the gutters, standings and alleys kept in a satisfactory sanitary state, there is not much likelihood of objectionable odours being absorbed by the milk during its passage from the udder to the can in the milk chilling vat.

The milk house and vestibule may be well constructed of concrete, stone, lumber or other suitable material. They should stand upon a solid foundation. The size of the milk house will depend upon needs. As in all buildings in which milk and milk products are handled, ample light and ventilation must be provided.

The interior surfaces must be smooth and free from crevices, and painted with a suitable white paint, capable of being washed and readily kept clean. The floor should be cement-faced and properly sloped to a drain. Doors and windows and any other openings through which flies and dust may gain access must be efficiently screened. The self-closing doors should open outwards.

Suitable devices must be provided within the milk house for the storing of empty cans and milking utensils, and only articles used directly in the production and handling of the milk must be kept in the building.

The surroundings must be capable of surface drainage and farm animals should not be allowed too close approach.

The interior of the milk house should be as clean a place as can be found upon the farm and will be kept so by an intelligent producer.

## WASHING AND STERILIZING MILK EQUIPMENT

Quantitatively there is no question that the most important source of contamination is constituted by unsterilized milk utensils. Each time they are used, a thin film of milk is left on the inner surface of these vessels which serves as an excellent medium for bacterial multiplication. Unless these organisms are destroyed by heat or chemical treatment, they serve to inoculate the next batch of milk.

It is imperative that this subject, to which too little attention is still paid, should be far more seriously appreciated by the producer. Only education will bring this about.

The cleaning of utensils may take place in a room off the milk house or some other suitable, convenient place. There are three essential steps in the adequate cleaning of milk utensils on the farm.

Firstly, there is no substitute for a thorough washing. The utensils, as soon as possible after being used, must be rinsed with cold or lukewarm water which will remove traces of milk and prevent filming. A thorough scrubbing with a suitable brush using hot water containing some reliable cleansing agent should be the next process, after which comes the second essential step—sterilization.

For this purpose steam under pressure is most satisfactory, but steam boilers are found only on a comparatively few farms. It is quite feasible, however, for the small dairy farm to have a home-made non-pressure steam sterilizer, for which there are several designs. The simplest perhaps is the galvanized iron tank, deep enough to contain the utensils to be treated. The tank contains a slatted bottom upon which pails, etc., are inverted. Heat comes from the under fire-box, and water for washing, etc., may be drawn off by a faucet, leaving one inch or so in the tank. This is very soon boiling and the steam rises into the pails, etc. In order that too much steam may not escape, a tight-fitting lid is required. To ensure satisfactory results the utensils should be treated for at least five minutes followed by rapid drying. Cloths for drying purposes should never be used after any method of sterilization.

Another and probably the commonest method of sterilization on the farm is by the use of boiling water. Results will depend very much upon the temperature and quantity of water used. This must be abundant. A teakettleful from the kitchen is not sufficient, and a boiler or tank set upon a coal-oil or laundry stove is necessary. The whole interior and exterior of the utensils must be carefully treated. More satisfactory than the pouring of boiling water upon the parts of equipment, is their immersion for several minutes in a tank of boiling water.

After either method, rapid drying out of any remaining moisture takes place when the utensils are placed on suitable racks provided for the purpose inside the milk house.

Except in areas which have been under competent supervision by health authorities, few farms will be found to be properly equipped for sterilization by means of either boiling water or steam. As an alternative method, chemicals of the chlorine group have been used. The preparation of the solution cannot be gone into here, but the effectiveness of its use depends upon three chief factors: a solution of sufficient strength; a sufficiently long period of contact between the solution and the entire inner surface of the utensils; and the absence of milk residue, dirt or other organic matter which destroys the sterilizing power of the solution.

It is unnecessary to dwell upon the need for the rigid application of these three requirements where chlorine sterilization is being depended upon, except to say that unless they are strictly carried out the results may be decidedly disappointing. Where there is a large number of utensils to be chemically treated, a tank containing solution may quite well be used, and the equipment immersed for at least ten seconds. The solution should be disposed of and a fresh supply used for the next sterilizing.

The cleaning and sterilization of all milking equipment, whether comprising hand milking devices or those employed in machine milking, are essentially similar, the results attained depending upon the thoroughness and care with which they have been carried out.

After sterilization it is of the highest importance that all equipment be adequately protected from sources of possible contamination, and it is highly advisable that just before again being used all interiors should be treated with a satisfactory chlorine rinse.

Cans carrying milk to the dairy plant must be adequately protected and facilities must be provided for keeping the product at a temperature never exceeding 50 degrees Fahrenheit.

In the foregoing have been presented very briefly the factors which call for rigorous attention in the production and handling of a milk fit for pasteurization. To recapitulate, they are:

1. Healthy, clean and properly prepared cows.
2. A healthy milker, clean in person and habits, and the use of sound utensils.
3. A well located, constructed and equipped cow-stable, kept in a sanitary state.
4. The adequate protection of the milk from the time it is drawn from the cow until ready for shipment.
5. The prompt straining and cooling of the milk.
6. A well constructed and equipped milk house.
7. The proper washing and effective sterilization of dairy utensils and their protection against recontamination until again used.

Most valuable information upon the whole subject of the production of pure milk may be had in pamphlet form upon application to the Division of Bacteriology and Dairy Research, Science Service, Dominion Department of Agriculture, Ottawa.

# Tests for Milk Quality*

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WHILE the term "milk quality" embraces a number of factors, for the purpose of the present discussion it will be considered as meaning freedom from excessive numbers of bacteria and leucocytes. Bacteria in milk are important as indicators of the care with which the milk has been produced and handled, as the cause of spoilage, and, in the case of a small number of species, as the cause of disease.

Routine bacteriological tests can tell us nothing about the safety of a given milk supply, hence the need for pasteurization. But the milk sanitarian must do more than merely assure himself that milk is properly pasteurized. Pasteurization should never be regarded as a process for making a poor quality milk acceptable, but rather as a means of guaranteeing the *safety* of a *good* raw milk supply. While a high-count milk may not necessarily be any more dangerous than one with a low count, the presence of numerous bacteria indicates that conditions on the farm are not right. Furthermore, such milk after pasteurization almost always has a higher count than is desirable, and will spoil sooner in the consumer's hands. For these reasons, milk sanitarians should be interested in improving the quality of incoming raw-milk supplies.

In this paper an endeavour will be made to discuss briefly the pros and cons of the most widely used bacteriological tests, bearing in mind that none of the methods available for determining the actual number of living bacterial cells in milk even remotely approaches the accuracy attained by such comparatively crude chemical tests as the Babcock test for butterfat.

Because it was the first in the field, the plate count is still regarded by some officials as the only acceptable yardstick by which the accuracy of more recent tests should be judged. On the other hand, research workers have long appreciated the shortcomings of the plate count method. While it is still the most satisfactory method for the examination of low count milks, there is a growing tendency to replace it with simpler, quicker and cheaper methods where the latter will furnish information of equivalent value. For example, in England a modified methylene blue reduction test has officially supplanted the plate count for the analysis of graded raw milks (7).

While the new agar used in making the bacterial plate counts is a decided improvement over the old, it should be recognized that the plate count is unable to reflect the true number of organisms present because of the uneven distribution of the bacteria in the milk, and of their tendency to occur in clumps, chains or

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masses. Consequently, the plate count reflects only a highly variable proportion of the actual number of bacteria present. When we are dealing with contamination from shipping cans, milking machines and other utensils, we frequently find large masses of bacteria in the milk. This important type of contamination, therefore, is not adequately indicated by the plate count (3, 4, 11).

Despite its faults, the plate count method is still regarded as the most useful for the examination of pasteurized milks. It may be, however, that with the phosphatase test to detect faulty pasteurization and the coliform test to detect subsequent contamination, less emphasis may be placed upon plate counts as measures of quality in pasteurized milk.

The plate count method is also relied upon for the detection of large numbers of heat-resistant bacteria in raw milks. By plating out these milks, pasteurizing them in the laboratory and replating, it is possible to determine which shippers are responsible for the bulk of this type of contamination. Usually faulty care of milking machines, strainer cloths, etc., is found to be at the bottom of the trouble. When these conditions are corrected, the efficiency of pasteurization is markedly increased.

As a means of measuring the bacterial content of incoming raw milk, the direct microscopic count, commonly referred to as the Breed count, is generally conceded to have many advantages over the plate count. Among these may be listed its inexpensiveness in equipment and materials, the provision of a permanent record, the ability to handle larger numbers of samples at one time, and the information furnished concerning the types of organisms present. It is frequently possible for the experienced analyst to decide whether high counts are due to faulty cooling, utensil contamination, etc., and also to determine roughly the probable degree of mastitis existing in a herd. When an aseptically drawn sample of milk is incubated at 37°C. overnight and then examined with this method, it ranks as one of the best methods for the detection of chronic mastitis. It also supplements the plate count in the detection of heat-resistant bacteria in pasteurized products.

Despite the advantages listed, the writer believes that the chief value of this test is as a supplement to one of the simpler dye reduction tests. With these tests (resazurin and methylene blue) it is possible to grade a large series of samples with an equal degree of accuracy and avoid the need for a trained technician, more expensive equipment and eye strain. The poorest milks may, if desired, be re-sampled the following day and examined by the Breed method so that the inspector or field man may be given some indication of the probable source of the high count.

The methylene blue reduction test was developed in Europe over thirty years ago and has been steadily increasing in popularity. In this test, the bacteria growing in the milk at body temperature lower the oxidation-reduction potential of the milk to a point at which the indicator, methylene blue, changes from blue to colourless. The fewer the bacteria present, the longer the time required for this change to take place. Despite the fact that various factors influence the relationship between the initial bacterial content and the length of time required

to bring about reduction, there is a considerable body of evidence that the reduction test indicates the bacterial content of the milk as accurately as do the counting methods previously referred to. Furthermore, it has the advantage that the reduction time is influenced by the state of activity of the bacteria. A poorly cooled milk will reduce more rapidly than a well-cooled milk of equivalent bacterial content. Few would argue that the former was as good a milk as the one in which the bacteria were dormant from adequate cooling.

There is one weakness of the present standard technique which the author feels should be remedied in the next edition of Standard Methods for the Examination of Dairy Products. During incubation, the rising cream sweeps a variable proportion of the bacteria, leucocytes, etc., to the surface. Where the bacteria are present in clumps, masses or chains, this proportion is very high, sometimes as high as 98 per cent of the total organisms (5). Since these bacteria at the surface have little influence upon the reduction potential in the body of the milk column, the reduction time for such milks is significantly longer than where the bacteria are redistributed throughout the milk column at intervals, and several times as many bacteria must be present in the milk before reduction of the dye takes place. Thus these milks are judged to be better than they really are. This creaming error can be almost entirely eliminated by inverting the rackful of tubes at intervals. In England, Wilson's modification, which is the standard method there (7), calls for inversion every thirty minutes. We have found little difference between inversion at intervals of thirty minutes, one hour and two hours (6). The longer intervals are obviously more convenient.

The modified test, in which the tubes are inverted periodically, shows much better agreement between replicate tubes than does the standard test. It also has the advantages of more uniform decolourization and a shortening of the reduction time, especially with the better grades of milk. For these various reasons, it is believed that the modified method should replace the present standard method.

With the limit for Class I milk now set at eight hours in the latest edition of Standard Methods (1), there is considerable inconvenience entailed in running the test. Consequently, there is marked interest in any method which promises to give similar information in a shorter space of time. The resazurin test, first described on this continent by Ramsdell and his co-workers (8), has been regarded by some as giving as much information in one hour as may be obtained by the methylene blue test in from five to seven hours (2, 8), and having the further advantage that physiologically or pathologically abnormal milks may be detected far more readily. In New Zealand, the test is being applied to individual quarter samples for the detection of mastitis (9).

As described by Ramsdell, the resazurin test consists of adding a solution of the dye resazurin to the milk to give a concentration of 1:200,000 and incubating for one hour at 37° C. Upon incubation, resazurin in milk changes from its original blue colour through various shades of purple and mauve to a full pink, which later fades, leaving the milk with its original colour. The samples are then graded on the basis of the degree of colour change at the end of one hour's incubation. Since in normal milks this colour change depends upon the

activity of the bacteria present, well-cooled milks containing large numbers of dormant bacteria may show little or no change in colour after one hour. This is exactly what we found in our studies (5). When, however, the incubation is continued until the pink colour is reached, we found an excellent correlation with the reduction time with methylene blue and a much better correlation with the Breed count. This pink end point is reached in approximately three-quarters of the time required to reduce methylene blue, a considerable advantage when dealing with high grade milks.

While the "resazurin pink" test detects high bacterial counts more reliably than the "one hour" test, it is less valuable in indicating abnormal milks. With the growing interest in the detection and elimination of mastitis milk, this is of some importance. We have therefore been seeking a modification of this test which will avoid the disadvantages of the "pink" and "one hour" methods. A careful study of data collected on 281 market milks has indicated that if the one-hour colour reading is supplemented by a further reading after three hours, it is possible to detect milks containing large numbers of either bacteria or leucocytes with a high degree of accuracy.[1] It should be mentioned in passing that in all our work the tubes are inverted at intervals to avoid the "creaming error" referred to above.

With both methylene blue and resazurin tests, tubes containing the dye-milk mixture are often held in ice water for periods up to two hours before being placed in the water-bath. During this period, an exhaustive creaming takes place, and if the cream layer is not redistributed, the reduction time may be significantly lengthened, as was pointed out by Thornton (10). Although the latest edition of Standard Methods for the Examination of Dairy Products (1) calls for inversion of the stoppered tubes five minutes after they are placed in the water-bath, this is often neglected. The importance of this creaming in ice water was forcefully impressed upon us recently in running the reazurin test with unstoppered tubes in a condensery. The rate of colour change observed was far slower than we have been accustomed to for milks of equivalent bacterial (Breed) count where tubes were inverted after five minutes and subsequently at hourly intervals.

Whether or not the resazurin test will supplant the methylene blue test remains to be seen. A great deal more work, particularly upon the chemistry of the dye, must be done before this can be decided. For the present it must be regarded as being a promising method, but still in the experimental stage.

In conclusion, it may be pointed out that any one of the methods discussed will furnish information which, if intelligently applied, will enable a considerable improvement to be made in most milk supplies. The choice of method therefore may be dictated by such factors as cost, simplicity and convenience. On

[1]*Since this paper was prepared, a "triple reading" test has been developed. This is based upon the time required for the dye-milk mixture to reach a shade half way between the initial and full pink colours. With this test, samples with high bacteria or leucocyte counts are readily detected and the series of samples classified into four grades within three hours. (Vide J. Milk Technology, 1940, 3: 320.)*

this basis, the dye reduction tests appear to have a definite advantage over the counting methods.

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## THE AMERICAN MEDICAL ASSOCIATION AND PASTEURIZATION*

SINCE disease germs are readily destroyed by well established methods of pasteurization, all milk for direct human consumption or for use in ice-cream, cheese or other milk products should be pasteurized according to officially approved methods. After pasteurization the milk should be so stored and protected that it will not be contaminated. Liquid pasteurized milk should be retailed in sealed bottles.

The pasteurization of milk is a public health measure. The public should demand pasteurized milk for drinking and the use of pasteurized milk in milk products. The dairy trade should universally adopt pasteurization in the interest of public health.

There is no cogent evidence that pasteurized milk is significantly inferior nutritionally to raw milk.

**Annual Report, International Association of Dairy and Milk Inspectors, 1935, page 51.*

# Transmission of Animal Diseases to Man Through Milk

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IT is entirely unnecessary here to go into a discussion of the value of milk as a food. For ages it has been one of the prime foods of man in many countries. However, the constituents of milk which make it of such supreme value have been discovered comparatively recently with the result that doctors and nutritionists in many parts of the world are urging its increased use, especially for infants and children. There is no adequate substitute for milk. The potential dangers of milk have also come to our knowledge comparatively recently. From the economic as well as the public health standpoints there has been a growing study of cattle, their proper breeding, rearing, and general care. This study has also led to the recognition of certain diseases common to cattle and to man. Our knowledge of some of these, undulant fever, for example, is very recent, especially as concerns the American continent. The controversy over the transmission of bovine tuberculosis to human beings has taken place largely in the present century, though some time earlier Landouzy quaintly expressed the danger by saying: "Cattle share with man the sad privilege of keeping alive the disease." There is now quite a list of diseases occurring primarily in the lower animals which are transmissible to man, but fortunately only a few of them are carried directly by milk.

## The Brucelloses (Undulant Fever, Mediterranean Fever) (1)

One of the first diseases carried from animals to man through milk which was recognized was undulant fever, accurately described by Marston in 1861 under the name Mediterranean or gastric intermittent fever, though there is reason to believe that it had occurred long before this in the Near East. It became such a factor in the disability of military and naval forces on the Island of Malta that the British government in 1904 sent a Commission to study its cause and prevention. One member of the Commission, Zammit, made the discovery that the goats which were the chief source of the milk supply of the Island carried the disease in their milk and that the drinking of the milk raw was the source of the disease in human beings.

It was not, however, until 1887 that Bruce, later the head of the British Commission, isolated the germ and gave to it the name *Micrococcus melitensis.* The disease was brought to the United States in 1905 through an importation of sixty-one female and four male goats from the Island of Malta, and in 1911 the disease was recognized as endemic in southwestern Texas and traced to the use of goat milk. In 1897 Bang isolated from aborting cows an organism, *Br. abortus,* which was proved to be the cause of infectious abortion in cattle, and in 1911 and 1912 it was shown that the udder of cows served as a reservoir for

this organism. In 1914 a closely related organism, *Br. suis,* was discovered in hogs by Traum. It has since been found in horses, chickens, cows, dogs, and human beings, all naturally infected.

In 1918 Evans showed that the organism discovered by Bruce and that by Bang were so closely related as to be differentiated with great difficulty. The nomenclature of these organisms has been confused and confusing. They are now classified as Brucella, in honour of Bruce, "who stands alone as an investigator of tropical diseases", and the disease caused by them described as brucellosis. Three varieties are recognized, *Br. melitensis, Br. abortus,* and *Br. suis.* The Brucella are widely spread and have been found in practically all parts of the world in both animals and man, while the disease in human beings is being recognized far and wide. In the United States there is no broad area known which is free of the infection both in animals and in man.

It has been found that the Brucella can penetrate the normal or minutely abraded skin. Bacteriologists in their laboratories are frequently infected. Packing-house employees and farm workers, especially men, rank high among those suffering from the disease. It is certain that in many of these cases milk is not the vehicle of infection, though in this country the majority seem to acquire the infection through the digestive tract. In the midwestern and southern states infection by the *Br. suis* shows a higher prevalence than other types, so that hogs are an important source of the more severe cases of brucellosis found in those areas of this country. In other areas the *Br. abortus* is found almost exclusively. Though it is one of the animal diseases carried to man through milk, it must be remembered that infection occurs also through the ingestion of other animal products and by contact.

In Canada the occurrence of brucellosis was recognized some twelve years ago. Dolman and Hudson (2) made two reports in 1938 covering twenty cases in and around Vancouver, all due to the consumption of raw milk. Examination of pooled raw milk monthly over two years showed that about fifty per cent of the samples gave complete agglutination in 1:25 dilution of a standard *Br. abortus* culture. They report that of 911 bloods sent in for the Widal test, thirty-two or 3.5 per cent agglutinated the *Br. abortus* completely in dilutions 1:20. This work indicates that the Brucella infection may be chronic and responsible for ill health in which no positive diagnosis is made. In 1938, Little (3) reported ten cases of undulant fever observed over thirteen months, occurring in Edmonton; all were raw milk consumers. In all Canada in 1937 less than 200 cases were reported (4).

## PATHOGENIC COCCI

There is no food of even approximate value which has been—and too often is—handled as carelessly as milk, while the housing and health of the producing cows have not until recently had the attention deserved. Even now, except for certain classes of animals, and those under supervision by authorities of large cities, cows are too much neglected.

One of the earliest outbreaks attributed to milk-borne infection was the "Hendon cow disease" or "milk scarlatina" (1886). This attracted much atten-

tion and was investigated by Klein for The Local Government Board. He isolated what he called *Streptococcus scarlatinae* from ulcers on the udder, and also from the blood of patients. He reproduced the disease in a calf by inoculation. His results were not accepted and are questioned today.

In France, Nocard (1887) in studying mastitis or "garget" isolated from the milk of such udders a streptococcus which he associated with the disease, proving that it was contagious. Though he did not succeed in causing illness in experimental animals, he suspected that milk from affected cows might be dangerous to consumers.

About the beginning of the twentieth century reports of epidemic tonsillitis or septic sore throat began to appear, first reported in the Scandinavian countries and England. In 1911 and 1912 the disease appeared in Boston, Baltimore, and Chicago, and in every case the source was traced to milk. In the Chicago outbreak, comprising some 10,000 cases, Davis isolated the streptococcus, which was found not only in the throats of the infected persons, but also in cases of mastitis in cows. Inoculation of healthy udders with this streptococcus produced a severe mastitis, thus completing the chain of evidence and clearing up the epidemiology of septic sore throat. To this organism he gave the name *Streptococcus epidemicus,* which is now one of the recognized pathogenic varieties. The studies on outbreaks in America show that practically every epidemic of septic sore throat was due to the consumption of milk containing this organism. We owe to Savage in England a series of studies on many aspects of milk and its relation to disease, including one on "garget". He was the first (1912) to collect data on the early epidemics in England, Scotland, and Norway, concerning which he says that nearly all may reasonably be said to have been spread by milk.

There has been much discussion as to whether the milk carrying the infection in these epidemics was infected after drawing by hands, utensils, carriers, etc., or became infected due to disease in the udder. Extensive studies indicate that septic sore throat epidemics occur from the taking of milks from herds in which there are cases of bovine mastitis caused by the *Str. epidemicus* Davis.

Frost and his coworkers have observed bovine mastitis from which they isolated a streptococcus, slightly different from the *Str. epidemicus* Davis, to which they have given the name *Str. zooepidemicus,* but so far no epidemics of sore throat have been proved to be due to this organism. It is considered by some unlikely that the bovine type of organism would produce disease in man, but Frost argues that the two organisms are so similar and the lesions produced in cows so much alike that the possibility of cross-infections must be considered.

The work of Klein in 1886 has been referred to. At that time Power definitely connected certain cases of scarlet fever with certain cows, but up to the present there is no exact evidence that cows suffer from a disease similar to scarlet fever and shed organisms capable of producing scarlet fever in human beings. That milk-borne scarlet fever epidemics occur is beyond question. A number of careful workers and students recognize the possibility that the germ causing scarlet fever may become implanted in the udder, multiply there, and be shed in the milk. An epidemic of scarlet fever bearing on this theory has been reported in Connecticut by Jones and Little, in which 200 persons were

affected, most of whom took milk from one farm. A case of scarlet fever had occurred there two months previous to the outbreak, and one of the milkers shortly before the outbreak had visited his home, where there was a child with scarlatina. When the milk from this farm was withdrawn and the general supply pasteurized, the outbreak ceased. From one cow in this herd of thirteen the Beta hemolytic streptococcus of the human type was recovered in enormous numbers.

One always tackles with hesitation problems in which the streptococci are concerned. Besides the many races of pathogenic streptococci there are also many saprophytic and parasitic varieties. There has been a great deal of confusion in their classification and nomenclature. The pathogenic streptococci are perhaps more important in their relation to human disease than any other disease-producing organisms. A number of pathogenic streptococci are met with in animals and produce in them serious and fatal illnesses, comparable to those seen in human beings.

In the above discussion of milk-borne infections the extensive studies of W. D. Frost (5) have been largely drawn upon. His classification and nomenclature have been adopted. It is only fair to say that these have not been generally accepted in their entirety but have been found useful, and for the purposes of this discussion seem to be adequate.

## TUBERCULOSIS

Of the animal diseases conveyed to man through the use of milk, tuberculosis is easily the most important. The question had its birth in 1865, when Villemin showed that tuberculosis was a communicable disease due to a virus which "behaves like a parasite. It multiplies itself and by itself." The disease "is not a spontaneous creation of the body. . . . To be born, a germ is necessary; it can come only from the outside." While the doctors discussed Villemin's findings, the veterinarians began experimenting and the great Chauveau began his classic experiments on infection through the digestive tract. The positive results obtained made him at once insist upon the necessity of taking precautions in regard to food supplies from tuberculous sources. Tuberculosis in cattle was not recognized as such at that time, but was known as "grape disease", and in France as "pommelière." Villemin held that inoculation would easily settle the question and as a result of this test declared that "calcareous phthisis of cows is identical in nature with tuberculosis in man."

After much controversy the general acceptance of the contagiousness of tuberculosis was due largely to the work of Cohnheim (1869) who had first opposed Villemin but later, in work at Breslau with Salomonsen, became convinced of the accuracy of Villemin's work and became one of his strongest supporters. In 1879 he clearly foretold the discovery of the tubercle bacillus which was accomplished by Robert Koch and announced in March, 1882, forever setting at rest the question of the contagiousness of tuberculosis.

It would be a grateful task to describe the many studies which were carried out and give the names of those who did them, but for the purposes of this paper it is necessary to mention only a few of the outstanding ones. In relation to the transmission of tuberculosis by the digestive tract we must always give especial

credit to some of the great veterinarians, especially Chauveau, Nocard, and Bang. Very early Nocard and Bang began an investigation to determine the danger to human beings of certain food products from tuberculous cattle, and also recorded observations bearing on this subject, one of which, as Nocard expressed it, "had almost the value of an experiment." Gerlach was the first (1866) to carry on feeding experiments with the milk of tuberculous cows. These experiments were begun at Hanover and later conducted on a much larger scale at the Veterinary School in Berlin. The results, published in 1875, were conclusive in showing that animals were readily infected by the ingestion of such milk.

It is fair to say that from that time until 1901 the danger of milk from tuberculous cattle to human beings was accepted and practically every country in the world in which the matter was considered at all had regulations in regard to tuberculosis of cattle and the use of products from tuberculous animals.

This was the situation in July, 1901, when the British Congress on Tuberculosis was held in London, where Koch, the most distinguished speaker, reversed his former statement, made when he announced the discovery of the tubercle bacillus: "Bovine tuberculosis is identical with human tuberculosis, and is thus a disease transmissible to man." As a result of experiments done with Schütz at the Veterinary School in Berlin, he gave as his conclusions:

"1. Human tuberculosis differs from bovine and cannot be transmitted to cattle.

"2. Though the important question whether man is susceptible to bovine tuberculosis at all is not yet absolutely decided, and will not admit of absolute decision today or tomorrow, one is, nevertheless, already at liberty to say that if such a susceptibility really exists the infection of human beings is but a very rare occurrence. I should estimate the extent of infection by the milk and flesh of tuberculous cattle, and the butter made of this milk, is hardly greater than that of hereditary transmission, and, therefore, do not deem it advisable to take any measures against it."

The first of these statements need not concern us here further than to say that the differences between the two types of tubercle bacillus were first pointed out by Theobald Smith in 1896, and since then have been extensively studied by a number of workers who in the main have confirmed Smith's results. To the English we owe the most persistent and complete study which has been made on this question.

It is not too much to say that Koch's second statement dumbfounded not only his audience, but the public. Lord Lister gave a courteous but trenchant criticism, though he had no new material to support his position. However, the authorities of the Congress felt it was necessary to oppose the position taken by Koch. For this purpose Dr. (now Sir) John McFadyean was selected and gave the leading address at a general meeting in Queen's Hall on July 25. On the morning of the same day, before Section III, the writer had read a paper (6) embodying the result of three years' study on the comparative virulence of the human and bovine types of tubercle bacillus, made at the laboratory of the State Live Stock Sanitary Board of Pennsylvania, located at the University of Pennsylvania. Within two hours a committee of the Congress, headed by Dr. Sims Woodhead, invited him to speak at the general meeting following Dr. McFadyean. He then reported some five cases of bovine infection of human beings,

one of which was in his assistant infected in the laboratory, three in veterinarians, and one in a cattle-car cleaner, all but one suffering only local lesions. Only one case was definitely proved by recovering the bacillus and showing it was of the bovine type, but the history of the other cases seemed conclusive. There was extension from the local lesion in one case ending in death.

At that time the writer had isolated at least one culture from a child seventeen months old who died of tuberculous meningitis at the Children's Hospital in Philadelphia. On postmortem examination it was considered by Dr. Alfred Hand, who gave us the material, the clearest case of primary intestinal tuberculosis he had ever found.

Mindful of Koch's dictum that the only sure diagnosis between bovine and the human tubercle bacilli was obtained by inoculation of cattle, we inoculated two calves weighing 132 and 202 pounds, and a three-year-old cow weighing 660 pounds. The calves died of acute tuberculosis in seventeen and twenty-seven days respectively, and the cow died in seventeen days. Needless to say, all three animals were carefully watched, temperatures taken, and after death careful postmortems done, all of which were recorded, photographs made, and specimens preserved. The results were given before the Pathological Society of Philadelphia on April 24, 1902. While many scientists, notably the English and Scandinavians, had always believed that the tubercle bacillus of the bovine type was capable of producing disease and death in human beings, this was the first recorded instance of tubercle bacilli having been isolated from a human case and proved to be bovine by inoculation into animals. Some three years later Theobald Smith isolated from a child another bovine organism (7).

Following the London Congress an English Royal Commission was appointed which has not only confirmed the results just described, but gone much further, and to the English work we owe the extent of our present knowledge concerning the danger of bovine tuberculosis to human beings. It has been the most extensive and continuous work of which I am aware (8).

It would be interesting from an historical standpoint to give a review of the many observations and studies made in different parts of the world, but we must content ourselves with some of the most recent summaries which have brought our knowledge up to date. There are other discussions which would be worth while, such as the routes by which tubercle bacilli gain entrance to the human body, whether the tubercle bacillus can pass through unbroken mucous membrane, the presence or not of the tubercle bacillus in the udder of the cow in the absence of lesions in that organ. Nocard, for example, held that tubercle bacilli could not enter the milk of a lactating cow unless there were distinct lesions in the udder. However, the Third Interim Report of the Royal Commission reports on two cows (A and B) whose milk in small doses often, though not always, produced tuberculosis in guinea-pigs when injected, though there were no macroscopic nor microscopic lesions of the udder detected. The milk of another cow (F) always caused tuberculosis in guinea-pigs yet four small lesions in one quarter were the only evidence of tuberculosis of the udder that could be found. It is also held by many that tubercle bacilli cannot pass through the unbroken mucous membrane of the intestinal tract, though authorities like Orth, Cornet,

Dobroklonski, Römer and von Behring have showed that bacilli, even as large anthrax, pass rapidly through the intestinal muscosa of guinea-pigs. Striking experiments along this line were done by Schlossmann and Engel, in Dusseldorf, Germany, and later by Ravenel and Reichel, at the University of Pennsylvania. Once organisms have passed the intestine they are evidently held for a longer or shorter time in the related glands, but once they have gained access to the thoracic duct the route to the lung is direct and rapidly covered, with the production of the hematogenous tubercle, as illustrated by Benda at the London Congress on Tuberculosis in 1901. Many observations have also been made on the tonsils as foci of infection.

For our present purpose we may omit these discussions and state positively that the ingestion of food carrying the tubercle bacilli can and does produce both localized and generalized tuberculosis in the human body. In all forms of tuberculosis caused by the bovine type of organism the highest incidence occurs in children under five years of age, and there is a distinct predilection for the glandular type (especially cervical), bones, and joints, though as seen by the following table (9) other organs are far from being immune, with a striking number of meningeal infections:

COMPILED FROM THE ROYAL COMMISSION ON TUBERCULOSIS REPORTS AND PAPERS PUBLISHED BY A. EASTWOOD, F. AND A. S. GRIFFITH, AND J. MENTON

| Variety of Tuberculosis | No. of cases | Percentage of cases infected with the bovine type of bacillus | | |
|---|---|---|---|---|
| | | Under 5 years | 5-15 years | All ages |
| Cervical gland | 128 | 91.3 | 54.2 | 50.0 |
| Lupus | 191 | 58.4 | 44.4 | 48.7 |
| Scrofulodermia | 60 | 53.3 | 43.3 | 36.6 |
| Bone and joint | 554 | 29.5 | 19.1 | 19.7 |
| Genito-urinary | 23 | — | — | 17.4 |
| Meningeal | 265 | 28.1 | 24.5 | 24.6 |
| Autopsies | 188 | 28.6 | 15.5 | 22.9 |
| Miscellaneous | 23 | 33.3 | 9.1 | 8.7 |
| Pulmonary (sputum) | 3,103 | — | — | 1.4 |

While the incidence varies slightly according to reports, the figures given by Morgan (10) may be accepted as fairly typical: under five years, 38.2 per cent; over fifteen years, 23.5 per cent,—showing a diminishing incidence with increase in age. The age incidence as well as the location of the primary lesion points unmistakably to milk as the great carrier of bovine infection to the human being. Again quoting from Morgan, there was 4.59 per cent pulmonary tuberculosis and 80.7 per cent abdominal tuberculosis.

For a number of years we were in the habit of believing that the bovine type of organism produced only lesions of glands, bones, and joints, but again we owe to the English workers the discovery that the bovine bacillus produces also pulmonary tuberculosis, of which 194 cases have been observed in Great Britain (1938) and a number in the Scandinavian countries—some 350 in the world. Griffith (9) states positively that pulmonary tuberculosis due to the bovine type is indistinguishable clinically from that due to the human type, and that of the 194 cases mentioned, both clinical and pathological evidence was that one-third

were clearly due to the alimentary tract as a portal of entry. The bovine bacillus is just as virulent for man as the human type.

While the study of bovine tuberculosis and its relation to human beings went on in England constantly, the public apparently did not take much interest, and the effort to insist on pasteurization of market milk met with little success, and indeed aroused in some places, Manchester, for example, strong opposition. In 1932, however, the famous actress, Olga Nethersole, was instrumental in getting together the People's League of Health and in forming a committee of sixty which contained a number of leading scientists in the country. Their findings must indeed have been startling to those who had not been studying the question. They found that there were 2,000 deaths and 4,000 new cases, mostly in children, occurring from bovine infection annually. Forty per cent of the cows were infected, while 0.2 per cent had udder tuberculosis; 40 per cent of the cattle slaughtered for food showed tuberculosis, and examination of market milk in various parts of the country showed from 2 to 13 per cent (average 6.7 per cent) living tubercle bacilli. These figures were quoted and endorsed by the Ministry of Health at that time.

Closely following this report came another from the International Society for Crippled Children (April 18, 1932) showing that from 10-15 per cent of the cases of bone and joint tuberculosis are of bovine origin; that of children who suffer from tuberculosis 21 per cent of the children 0-5 years of age, and 26 per cent from 5-16 years are infected by the bovine type of tubercle bacillus.

It does not seem necessary to go further into figures. The writer knows of no one in any country whose opinion is worth having who does not now acknowledge the danger to human beings of tuberculosis in cattle. It is curious, since the danger is chiefly to children, whose health means so much to every country and whose welfare arouses in all some of the most worthy sentiments the human being is capable of, that opposition to laws and regulations which would ensure safe milk is still so often met with.

It is always better to rout an evil at the source. There can be no question that the eradication of tuberculosis from our dairy herds should be our ideal. From the purely economic standpoint it is worth while, but when we consider the bearing it has upon the health of our children, further argument seems superfluous. That it is a gigantic task goes without saying. It hits certain interests hard at the beginning, though eventually it must be a benefit, and there are some curious involvements which we need not go into here. However, it can be done. The situation in the United States is an example of what can be accomplished. The modified tuberculosis-free accredited areas have increased year by year, so that now all the States are so classified with the exception of California, where there are two counties in which the work has not been completed. The initial tests of all the herds in these counties have been made, and it is expected that the incidence of infection will be reduced to a point where they can soon be placed in the modified accredited area. Likewise, all the municipalities in Puerto Rico as well as the Virgin Islands are in the modified area.

In the meantime, pasteurization of all market milk should be demanded. It is the sovereign remedy against the danger of bovine tuberculosis. From

Canada (11) we have some of the strongest evidence supporting the pasteurization of milk. In 1926 Price began an investigation to determine the extent of tuberculosis in children and the role played by milk as a carrier of the disease. She has studied a series of 500 tuberculous children in whom 9.6 per cent of the extrapulmonary cases were due to the bovine type. The striking point is that no children of Toronto, where pasteurization has been enforced since 1915, showed bovine infection, all of the cases coming from outlying places where pasteurization was not compulsory. Apart from tuberculosis there has been no milk-borne outbreak of disease in Toronto since 1915. Studies of the milk used in Toronto showed that 26 per cent of 200 samples showed living bovine bacilli before pasteurization, but of 100 samples after pasteurization none were positive. The report emphasizes what both the CANADIAN PUBLIC HEALTH JOURNAL and the *American Journal of Public Health* have stressed for a number of years,—that in addition to being a safeguard against tuberculosis, pasteurization eliminates the danger from other milk-borne infections, such as undulant fever and those due to staphylococci and streptococci.

Many experiments, notably those done at the National Institute for Research in Dairying, Reading, England, have shown that proper pasteurization, which is not difficult to attain, though it requires constant supervision by the authorities, does no harm to the nutritive properties of milk. The Lancet for February 18, 1939, summarized experiments on this point. Two hundred and fifty calves divided into approximately equal groups were fed respectively raw and pasteurized milk. No statistical difference was found in the rate of growth, though there was a slight advantage shown by those fed on pasteurized milk. Other experiments on human beings, rats, mice, and calves have proved that any damage done to milk by pasteurization is, for practical purposes, negligible. In the five years elapsed since the Royal College of Physicians presented its plans for a safe milk supply, it is estimated that in England there have been 10,000 deaths from bovine origin, 2,000 cases of undulant fever, and 16 milk-borne epidemics affecting 3,400 persons and causing 67 deaths. Further argument for the duty of pasteurization seems unnecessary.

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# The Present Status of Milk-Borne Disease Hazards*

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THE reiteration of well-worn themes, and the pouring of new wine into old wine skins, are rather unenviable assignments at any time and before any group. Nowadays especially, when so many of our kith and kin are rushing to cover from forces of destruction incomparably swift and lethal, one can hardly avoid sensing an extra touch of irrelevance and incongruity about the task of assessing, before this Association, the familiar enough hazards of milk-borne disease. There are few novel facts or recommendations to present, but against the tragic background of war the topic may perhaps serve to illustrate how, even in connection with this rather elementary public health matter, there is need for the spirit of prophylaxis to replace that of procrastination.

The plan which it is proposed to follow is to comment on the apparent incidence of certain milk-borne diseases in Canada and the United States in recent years, and to discuss some of the factors governing this incidence and its trend.

## Incidence of Milk-borne Disease in Recent Years

The actual incidence of milk-borne disease is obviously far higher than the recorded incidence, but no very close estimate of the former in terms of the latter can be made, owing to the many weak or missing links in the chain of evidence. For instance, some proportion of cases may not seek medical attention; while of those cases coming under medical care, not all will be correctly diagnosed; and of those correctly diagnosed, some cases will not be reported. Even if reported, the cases may not be attributed to a faulty milk supply. When the milk supply is suspected, no epidemiological investigation may be conducted; or, if carried out, the findings may not be officially recorded. Finally, reports of milk-borne outbreaks may remain on local files, and never come to the attention of a central national agency charged with the responsibility of systematically recording and annually publishing a summary of such outbreaks.

The extent to which the above factors reduce the recorded incidence of milk-borne diseases will vary with the particular disease. Comparatively few outbreaks of typhoid fever, for instance, are likely to escape medical supervision. On the other hand, it seems certain that official figures give an altogether inadequate picture of the actual incidence of brucellosis, owing to the high percentage of mild, ambulatory types of this infection, to the continuing unfamiliarity of many physicians with both the clinical and the public health aspects of this

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disease, and to the sporadic nature of its occurrence among those consuming infected raw milk. Again, in a condition like staphylococcal poisoning of milk or milk products, the fact that the consumers' resulting symptoms may be so readily attributed by either patient or doctor to "food sensitivity", to "dietary indiscretion", or to some similarly vague euphemism, ensures that reports of the milk-borne nature of such attacks will rarely reach the statistical authorities.

The true incidence of milk-borne disease is even more difficult to assess in Canada than in the United States, for since 1923 the United States Public Health Service has published an annual survey of milk-borne outbreaks, whereas no such system has yet been instituted in Canada. After fifteen years of this laudable system the average annual number of recorded outbreaks in the United States rose from 17 to about 42, but Frank (1) notes that New York State, California, and Minnesota together reported in 1938 nearly as many milk-borne outbreaks as all the rest of the country combined, although these three States represent only about one-sixth of the entire population covered by the survey. For that year he estimates there were probably 5 to 10 or more times as many outbreaks, cases, and deaths in the United States from milk-borne infection as were reported.

TABLE 1

RECORDED OUTBREAKS OF MILK-BORNE DISEASE IN CANADA ACCORDING TO DIAGNOSIS (1912-1939)

| | *Outbreaks* | *Cases* | *Deaths* |
|---|---|---|---|
| Typhoid fever | 51 | 7015 | 729 |
| Paratyphoid fever | 6 | 557 | 7 |
| Scarlet fever | 7 | 192 | 0 |
| Septic sore throat | 3 | 584 | 4 |
| TOTAL | 67 | 8348 | 740 |
| ANNUAL AVERAGE | 2.4 | 298 | 26.5 |

The figures of milk-borne outbreaks in Canada over the twenty-eight year period 1912-1939 have been summarized, according to diagnosis, in table 1. Application of Frank's correction factor to these Canadian figures suggests that the minimum annual incidence of milk-borne typhoid and paratyphoid fevers, scarlet fever, and septic sore throat would average 12 outbreaks, involving roughly 1500 cases and 130 deaths. Tuberculosis of bovine origin, and brucellosis, are omitted from the list, since neither occurs typically in epidemic form. The prevalence of bovine tuberculosis is obviously difficult to determine, but the figure of 9.6 per cent obtained by Price (2) for the incidence of extra-pulmonary tuberculosis of bovine origin in Ontario children over the 13-year period 1926-38, suggests that those communities in Canada which do not enjoy compulsory pasteurization of milk must contribute many new cases of bovine tuberculosis annually. If only 5 per cent of cases of extra-pulmonary tuberculosis in Canada were of bovine origin, the preliminary figures for 1939 (3), showing 1032 deaths from this cause, would indicate that around 50 deaths annually, and of course a much larger number of cases, should be ascribed to milk-borne tuberculosis. The incidence of brucellosis is even more difficult to estimate, for reasons already suggested. But since 1929, when cases first began to be recognized in Ontario,

around 100 cases have, on the average, been recorded annually throughout Canada. Presumably Ontario's contributions to the annual total of brucellosis cases recorded will henceforth be markedly reduced; but as there are no signs at present of other Provinces following her excellent example in the matter of pasteurization of all milk supplies, it seems likely that the awakened interest in this disease evinced by practising physicians, health officials, and laboratory workers, will soon re-establish the recorded annual total at not less than 100 cases. If this number be also multiplied by five (which for brucellosis would almost certainly entail a gross under-estimate), another 500 cases of milk-borne disease must be added to the previous total, making the annual average some 2000 cases. This total excludes cases of milk-borne tuberculosis, and also attacks of food poisoning due to staphylococcus enterotoxin elaborated in milk or milk products, whose incidence defies estimation from the limited data available.

TABLE 2

RECORDED CASES OF CERTAIN MILK-BORNE DISEASES IN CANADA, GREAT BRITAIN, AND UNITED STATES

(*Annual Averages*)

| | *Canada* (1912-39) | *Great Britain* (1912-31) | *United States* (1910-33) | *United States* (1938) |
|---|---|---|---|---|
| Typhoid fever, paratyphoid fever and dysentery | 270 | 105 | 352 | 353 |
| Scarlet fever and septic sore throat | 28 | 191 | 1337 | 674 |
| Diphtheria | ... | 40 | 45 | 31 |
| TOTALS | 298 | 336 | 1734 | 1058 |

Figures for Canada calculated from data given in Table 1.
Figures for Great Britain calculated from Wilson, G. S., Lancet, 1933, **224**: 829.
Figures for United States (1910-33) taken from Borman, E. K., West, D. E., and Mickle, F. L., Am. J. Pub. Health, 1935, **25**: 557.
Figures for United States (1938) taken from Frank, L. C., U.S. Pub. Health Rep., 1940, **55**: 1373.

In table 2 an attempt has been made to compare the average annual figures for milk-borne diseases in Canada with similar figures for the United States and Great Britain. Clearly we should not attempt to read too much significance into these figures, for apart from the general reservations cast upon them by preceding comments, they are derived from surveys covering unmatched periods of years. However, certain points seem noteworthy. For instance, Canada appears to have a disproportionately high average number of annually-recorded cases of milk-borne diseases. On a population basis, the figures corresponding to a Canadian total of 298 would be around 3600 for the United States and about 1200 for Great Britain. This relatively big Canadian total can hardly be attributed to more efficient reporting. It is, in fact, entirely due to a high recorded incidence of milk-borne enteric infections, among which typhoid fever looms largest. (No cases of milk-borne dysentery are on record for Canada, although the totals given in the table for Great Britain and the United States include appreciable numbers of such cases.) Whereas Great Britain, over a comparable period, recorded an annual average of 105 cases for typhoid fever, paratyphoid fever, and dysentery

combined, the corresponding figure for Canada, with one-quarter the population, was 270. On the other hand, despite its twelve times greater population, the recorded total incidence of enteric infections in the United States over the past twenty-five years or so has averaged each year only 30 per cent higher than in Canada. Admittedly, the Canadian figure is heavily weighted by the inclusion of 5002 cases of typhoid fever reported in the disastrous Montreal epidemic of 1927. But even if this epidemic be excluded by considering the figures for only the most recent ten-year period, 1930-39, there would still be an annual average of 121 recorded cases of milk-borne enteric infections, which remains unduly high as judged by the figures for Great Britain and the United States. The United States figures for 1938, separately listed in the table, show no diminution in the number of milk-borne typhoid-paratyphoid-dysentery cases recorded during that year, when compared with the annual average obtaining for the period 1910-33. It is disconcerting to note, on reference to the year-by-year figures for Canada, that in this country also there is no downward trend yet discernible in the incidence of milk-borne enteric infections.

Before leaving this sketchy outline of the incidence of milk-borne diseases, it should be pointed out that although the total recorded cases of water-borne disease may outnumber the corresponding total for milk-borne disease, the converse is apparently true of recorded deaths. For instance, the annual averages of deaths from water and milk-borne diseases recorded in the United States over the six-year period 1924-29, were 48 and 62 respectively; while in 1938, water-borne disease caused 17 deaths, as compared with 27 deaths from milk-borne disease.

## FACTORS GOVERNING THE INCIDENCE AND TREND OF MILK-BORNE DISEASE

The incidence of milk-borne disease may be deemed governed, for all practical purposes, by the following three main groups of variables:

(1) The distribution among dairy cattle of tuberculosis, Bang's disease, and of streptococcal and staphylococcal mastitis.
(2) The extent to which handlers of milk and milk products may be infected with, or may carry, micro-organisms of the typhoid-paratyphoid-dysentery group, Group A streptococci, enterotoxigenic staphylococci, or diphtheria bacilli.
(3) The extent to which supplies of milk and milk products are effectively pasteurized.

As marked fluctuations in any component of these groups of variables will inevitably be reflected in the apparent trend of milk-borne disease incidence, certain of these components will be briefly discussed.

### *Tuberculosis among Dairy Cattle*

The fact that a positive tuberculin test has a more clear-cut significance among cattle than in man, has permitted real progress to be made in the eradication of bovine tuberculosis. Since 1897, when the Dominion Department of Agriculture appears to have taken the first official step in a since greatly expanded program of tuberculosis control, by supplying tuberculin free of charge to qualified veterinarians in return for full reports on the results of the tests, the incidence of bovine tuberculosis has declined, until today it is believed not to

exceed 3 per cent of the 9 million or so cattle in Canada (4). But this presumed incidence is arrived at from the results of tuberculin testing carried out upon some 250,000 cattle in "accredited" herds, some 600,000 in "supervised" herds, and some 2¼ million in "restricted areas", in all just over 3 million head, or roughly one-third the total cattle population of Canada. In view of the extremely wide range of reactors, from 0.01 per cent to 34.0 per cent found in the different localities tested during 1939 (5), it seems quite possible that the incidence of bovine tuberculosis among the six million remaining cattle might be higher than the estimated 3 per cent. However, even a 3 per cent incidence of tuberculosis among dairy herds represents a public health hazard whose proportions do not seem significantly diminished by the rather quaintly-phrased statement appearing recently in a veterinary journal, that "approximately 55 per cent of the human population is so located that they are privileged to consume milk from tuberculin tested cattle". Again, although great benefits to public health and agriculture have undoubtedly accrued from the policy of eradicating bovine tuberculosis by tuberculin testing, and by slaughtering reactors with compensation to farmers, it is difficult to see how any marked further decline in the incidence can be achieved until the present rate of slightly over one million tests annually be substantially increased. In the twenty-year period 1920-39, over $12,000,000 has been paid by the Dominion Department of Agriculture in compensation to farmers for slaughtered tuberculous cattle. But no compensation has been paid to the parents of children killed or crippled by milk-borne tuberculosis. Until greatly increased funds are available for tuberculin testing and for slaughter compensation, and until a more uniform distribution of tuberculin testing is secured so as to reduce the disparity between such figures as 4 per cent of cattle tested in Alberta, for instance, and 100 per cent tested in New Brunswick and Prince Edward Island, tuberculous cattle will not be eradicated from Canada. Meanwhile, pasteurization of all milk and milk products is of course the only completely satisfactory means of preventing bovine tuberculosis in man.

*Bang's Disease*

The actual incidence of Bang's disease among dairy cattle throughout Canada appears to be wholly conjectural, for few blood agglutination surveys have been recorded, and these showed a wide range of positive percentages. For example, Marriott (6) reported an incidence of 1.7 per cent positive among some 16,500 dairy cows from the dried-out areas of the West in 1937, and of only 1.37 per cent positive among about 70,000 cattle tested in 1938. On the other hand, Hardman (7) stated in 1933 that 15.5 per cent of milk cows in Ontario were infected with Bang's disease, while in British Columbia the incidence appears to be even higher, in some localities probably half or more of the cattle being infected. The unusually high prevalence of Bang's disease in British Columbia has afforded opportunities for several small-scale studies in Vancouver during the past five years on the problem of human milk-borne brucellosis, some of which have already been reported by Dolman and Hudson (8) and by Dolman, Hudson and Mathias (9). Continuation of these studies to date has borne out previous findings. On this occasion, it is proposed merely to emphasize a few points bearing on the relationship between Bang's disease and human brucellosis,

since many farmers, a few veterinarians, an occasional medical health officer, and possibly even the odd bacteriologist, still appear to doubt the existence of such a relationship.

Over the past five years, among 3090 whey specimens obtained from bottled samples of pooled raw milk taken at random by sanitary inspectors from wagons delivering in the Vancouver area, 1570, or 50 per cent, have given complete agglutination in 1:25 or higher whey dilutions; while at 1:50 or higher dilutions, the corresponding figures have been 1147, or 36.3 per cent. Since whey agglutinin titres are usually lower than those of blood from the same cow, the high proportion of reactor herds from which Vancouver obtains its milk supply is evident enough. Moreover, in view of the reports of Traum (10), and Gwatkin (11), that 40-50 per cent of reactors among cattle excrete *Br. abortus* in their milk, the findings shown in table 3 are not surprising. This table summarizes

TABLE 3

ISOLATION OF BR. ABORTUS FROM POOLED RAW MILK SUPPLIES VANCOUVER

| *Period of Survey* | *No. of Different Dairies Examined* | *Dairies Yielding Positive Samples* |
|---|---|---|
| April–May, 1938 | 32 | 8 |
| June–August, 1938 | 48 | 5 |
| Nov., 1938–Jan., 1939 | 48 | 9 |
| May–August, 1940 | 42 | 12 |

the results of four surveys carried out intermittently in the Provincial Laboratories at Vancouver by my colleague Miss V. G. Hudson. In each survey, one, two, or three bottled samples were cultured from each raw milk distributor during the period stated, the samples being collected from delivery wagons by sanitary inspectors at roughly monthly intervals. The numbers of different dairies yielding readable plates are given in the first column of the table, while the numbers of different dairies yielding one or more positive cultures are given in the second column. The proportion of dairies yielding positive cultures ranged from 10.4 to 25 per cent in the different surveys, but throughout the ten months during which surveys were being conducted, positive cultures were obtained on at least one occasion from no less than 22 different dairies among a maximum of 48 raw milk distributors. Had it been possible to make more frequent cultures, no doubt something approaching unanimity in respect of the occasional presence of *Br. abortus* might have been demonstrated among the various distributors. Incidentally, in the most recent of the four surveys listed, samples giving positive cultures were obtained from 6 of the City's 9 so-called "preferred raw milk" distributors, for whose product consumers paid a higher price.

The local brucellosis hazard resulting from consumption of such a raw milk supply as this has been discussed in previous communications (8, 9), but the figures may fittingly be brought up-to-date. Over the past nine years or so, of 9167 blood specimens from Vancouver residents reaching the Provincial Laboratories, 350, or 3.8 per cent, have shown complete macroscopic agglutination against standardized Brucella suspensions in serum dilutions of 1:20 or higher.

It should be pointed out that the majority of these suspensions were taken for routine laboratory tests, and also that around 70 per cent of the population of Vancouver customarily drink pasteurized milk. (In Victoria, where less pasteurized milk is consumed, a similar type of survey conducted over a recent six-months' period by my colleague Dr. Gordon A. McCurdy, showed that among 2425 blood specimens, 10 per cent were positive for Brucella agglutinins in serum dilutions of 1:20 or higher.) Further analysis of the limiting titres of these 350 cases with specific agglutinins reveals that 188 had a Brucella agglutinin titre of 1:80 or higher, while 70 showed a titre of 1:1000 or higher. The former titre is often regarded as indicative of present or recent infection, while the latter titre, in our local experience, has almost invariably been associated with clinical evidence of acute brucellosis. In the past four years, during which blood culture has been performed, wherever possible, on cases with serological and clinical evidence of acute brucellosis, positive cultures were obtained in 18 out of 42 typical cases among residents of Vancouver, all of whom had regularly consumed raw milk. Moreover, during the periods when representative raw milk samples were being cultured, there were 10 typical cases of acute brucellosis, 5 of them yielding positive blood cultures, in which the infection manifested itself within a few weeks of our isolation of *Br. abortus* from the patient's customary milk supply.

The value of such findings as these in convincing the sceptical, is apt to be neutralized by a tendency of the uninitiated to regard them as a basis for unsound policies. In particular, rather than face the problem of enforcing pasteurization, attempts may be made to introduce some such half-measure as the banning of raw milk distribution by dairies liable to be the source of human brucellosis. Apart from the fact that in an area where Bang's disease is very prevalent, rigorous enactment of such a ban would bring ruin to many local farmers, the scheme ignores the practical and theoretical impossibility of any public health laboratory carrying the onus of stating which dairies should come under the ban. The method of culture would be far too involved and too slow, even if infected cows could be relied on to excrete *Br. abortus* in generous numbers at regular intervals; while whey agglutinin titration is, after all, a test for the presence of antibodies: a fact which seems often forgotten. The positive reactors among cattle are partially immune cows, and some of them may already have overcome the infection at the time of testing. On the other hand, a cow may give a negative blood or whey agglutination reaction, and yet excrete *Br. abortus*. Pasteurization admittedly does not solve the problem of Bang's disease for the dairy farmer, but there is no substitute for this measure in the control of milk-borne human brucellosis.

*Streptococcal and Staphylococcal Mastitis in Cattle*

Little need be said in regard to streptococcal bovine mastitis, since the consensus of the voluminous literature on the subject is that Group A streptococci are rarely found in either the healthy or the diseased bovine udder, while streptococci of those groups more frequently found there, particularly Group B, rarely prove pathogenic for man.

From the public health standpoint, staphylococcal mastitis is of far greater importance. Nicolle and Césari (12) first reported in 1914 that filtrates capable of causing skin necrosis (due to alpha toxin) in rabbits and guinea pigs could be obtained as readily from staphylococcal strains isolated from bovine as from human lesions. In the same year, Barber (13) wrote his classic report of gastro-enteritis following consumption of cow's milk containing a white staphylococcus, thus blazing a trail which Jordan and many others were to pick up later. The frequent association of staphylococcal food poisoning with milk and milk products (including cheese and even ice cream) is now fairly well recognized, and is doubtless often due to excretion of enterotoxigenic staphylococci in the milk of cows with mastitis, or even in the milk of apparently healthy cows, to which Gwatkin (14), Minett (15), and others have drawn attention. Since staphylococcus enterotoxin is relatively heat stable, pasteurization could have no significant effect upon preformed enterotoxin in milk. But pasteurization cer-

TABLE 4

HAEMOLYTIC STREPTOCOCCI AND BETA-TOXIGENIC STAPHYLOCOCCI IN RAW AND PASTEURIZED MILK SAMPLES VANCOUVER SUPPLY

| | *Raw* | *Pasteurized* |
|---|---|---|
| No. of samples plated on sheep blood agar | 74 | 61 |
| Samples showing haemolytic streptococci | 23 (19 Group B, 2 Group C, 2 Group E) | 0 |
| Samples showing beta-toxigenic staphylococci | 64 | 1 |

tainly kills the great majority of enterotoxigenic staphylococci in milk, whether these have arisen endogenously from the udder, or have been introduced exogenously from the hands or by naso-pharyngeal droplets of the milker. Table 4 records the results of a survey carried out by my colleague, Miss D. E. Kerr, and forcibly illustrates the effectiveness of pasteurization in reducing the hazards of milk-borne streptococcal infection and staphylococcal food poisoning. Facilities did not permit submission of the staphylococci to the kitten test for enterotoxin production. But since a high proportion of beta-toxigenic strains (readily distinguished by the wide zone of modified haemolysis around colonies on sheep blood agar plates) are also enterotoxigenic, the presence of strains having the former property may be deemed valid evidence of the probable presence of strains having the latter property.

*Typhoid Carriers*

Little is known of the incidence in Canada of typhoid-paratyphoid-dysentery carriers, but reference has already been made to the unduly high incidence of milk-borne typhoid in this country, and typhoid carriers among milk handlers are presumably responsible for this. Surveys conducted in the United States have shown a typhoid carrier incidence ranging from a low rate of roughly 1 for every 100,000 stool examinations made in New York City (16) up to as

high as 1 in 332 among food handlers in Albuquerque, New Mexico (17). Opinions have differed as to whether the expense of detecting unsuspected typhoid carriers by surveys of this type was justified. The wide range of incidence represented by the above figures suggests an important argument in favour of such surveys in certain areas, namely, that the cost of detecting a carrier will tend to be lowest in those areas which most need surveying because of high carrier rates. In communities having an unduly high typhoid fever incidence, regular and thorough examinations of all food handlers, particularly handlers of milk and milk products, would seem warranted, from the economic as well as the public health standpoint.

*Cheese-borne Typhoid*

During the eight-year period 1932-39, there have been no less than 6 known cheese-borne typhoid outbreaks in Canada, involving 760 persons, with 71 deaths. In each instance, the cheese was of Cheddar type, and was made from raw milk. Pollution of a portion of the milk reaching the cheese factories by a typhoid carrier appears to have been the cause of each outbreak.

No really important argument against the use of pasteurized milk in the manufacture of Cheddar-type cheese has been advanced. All exported New Zealand cheese of this type has been made from pasteurized milk for some years, with many resulting advantages to the uniformity, as well as safety, of the product. Cheddar cheese manufactured from pasteurized milk apparently exhibits a slower rate of maturation, and a milder flavour. But the specially potent flavour sought by the connoisseur does not particularly appeal to the vastly more numerous plebeian, who apparently prefers his cheese mild, for most Canadian Cheddar-type cheese is consumed within a few weeks of the date of manufacture. The Dairy Industry Act (1937) encourages this rapid distribution and consumption of cheese by imposing no specific regulations upon its storage, other than to prohibit its boxing for export within eight days of the date of manufacture. According to some preliminary findings of Ranta and Dolman (18), prolonged storage of typhoid-infected cheese would be necessary before it could be consumed with impunity. There would seem to be no valid reason why a cheese supply, rendered safer than at present from typhoid hazards by being made from pasteurized milk, should not be assured to consumers both at home and abroad.

*Other Types of Carriers*

According to Hare (19) 7 per cent of normal persons are naso-pharyngeal carriers of Group A streptococci, and he has shown that such carriers not only expel these micro-organisms when speaking or coughing, but also (20) frequently show heavy and persistent pollution of their hands and clothing therewith. The risk of milk-borne outbreaks of scarlet fever and septic sore throat due to carriers of Group A streptococci among milk handlers seems so considerable that the figures given in table 2 under this heading, and more especially those given for Canada, must be deemed very incomplete.

The incidence of naso-pharyngeal carriers of enterotoxigenic staphylococci is probably higher still, and Roberts and Wilson (21) have reported an interest-

ing example of the consequence of employing such persons as food handlers. Milk-borne outbreaks of food poisoning due to carriers of enterotoxigenic staphylococci are probably quite common, although no Department of Health has made the condition reportable.

While pasteurization will not protect the consumer against the effects of streptococci or staphylococci introduced into milk or a milk product after its purchase, it is certainly the best safeguard against carriers of these, or indeed of any pathogenic micro-organisms, among milk handlers.

In connection with milk-borne outbreaks of diphtheria, one need only reflect here that the absence of any record of such outbreaks in Canada during the period reviewed, may be largely due to programs of diphtheria control which, while far from ideal, have been at least progressive and effective.

*Pasteurization*

The one factor which, more than any of the other variables in question, will determine the milk-borne disease hazards faced by a given community, is the extent of efficient pasteurization of its supplies of milk and milk products. Rosenau has somewhere likened pasteurization of milk to Banquo's ghost, and its frequent reappearances on programs of public health associations are indeed surprising and conscience-smiting. It is now seventy-five years since Pasteur published his account of a "practical procedure for the preservation and improvement of wines". In passing, it is interesting to note the very thorough heating which he recommended for wines, over a range of time and temperature whose lower limits, if advocated for milk, would place him quite beyond the pale to those who are so anxiously concerned about an irrelevant cream line and a stable flavour.

PROCÉDÉ PRATIQUE DE CONSERVATION ET D'AMÉLIORATION DES VINS

". . . lorsque du vin est mis en bouteille, le germe de sa maladie est enfermé avec lui. Pour conserver le vin, il fallait donc trouver le moyen de tuer ce germe . . . . . Enfin j'ai essayé l'action de la chaleur, et je crois être arrivé à un procédé très pratique, qui consiste simplement à porter le vin à une température comprise entre 60° et 100°, en vases clos, pendant une heure ou deux."—(L. Pasteur, Etudes sur le vin, 1865.)

In the past ten years or so, repeated efforts have been made, especially by this Association, through symposiums, through special Milk Numbers of the JOURNAL, and through reports by Special Committees, to accelerate the rate of adoption of 100 per cent pasteurization by all municipalities throughout Canada. With the notable exception of Ontario, whose success in achieving province-wide pasteurization is being reported by Dr. A. E. Berry (22), the number of municipalities requiring pasteurization of all milk distributed is lamentably small. In fact, no matter how strongly-worded our unanimous resolutions may be, they seem to break up on the shoals of municipal politics; of obscure bounds of jurisdiction, and differences of objectives, as between Dominion and Provincial Departments of Health and of Agriculture; of false and often vicious propaganda on the part of some raw milk producers, and the vested interests behind them; and of a noisy minority of cranks who, through an oddly-perverted Oedipus-fixation, seem to regard the rendering of milk safe by pasteurization as insulting to the cow.

The time has arrived, it would seem, for a more militant attitude in regard to pasteurization to be carried right into the field by all public health workers. The negligible effects of the process upon the vitamin content of milk, upon the assimilability of its calcium and phosphorus content, upon its general nutritive values, have all been repeatedly demonstrated. Far more important than such negative consequences of pasteurization are the positive facts that not a single outbreak of disease has ever been traced to properly-pasteurized milk or milk products; and that the phosphatase test now provides a simple and effective method of ensuring proper pasteurization.

To those who, while admitting all the facts in favour of pasteurization, yet seek to beguile the hour with thoughts of how relatively slight are the hazards of milk-borne disease today, one cannot do better than offer an aphorism from Pasteur himself: "Le plus grand déréglement de l'esprit est de croire les choses parce qu'on veut qu'elles soient." Which, being translated into current idiom, reads pertinently enough: The worst irregularity of the mind is wishful thinking.

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# Contagious Abortion of Cattle and Undulant Fever in Man*

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ALTHOUGH contagious abortion has been recognized as a disease common to this country for years, and its economic importance has been fully appreciated by many breeders, very little was done about it in Western Canada until its importance as a public health problem was appreciated. For some unknown reason, cattle owners although fully aware of the presence of contagious abortion in their herds kept their knowledge to themselves, and only when they were sorely pressed by heavy losses would they seek assistance from outside sources, and not until all the empiric remedies on the market had been tried and failed. As a result of such practices, and because of the sale of infected cows, the disease became extremely prevalent in certain districts, as was later shown when systematic testing of dairy herds was attempted. Because of its known prevalence in these districts it became generally accepted that the disease was common throughout the province, and that most dairy herds were infected. This idea was further strengthened because of the fact that any testing which had been done was confined to herds where the disease was suspected or known to exist, with the result that the percentage of reacting animals located was extremely high. Since this was the situation when undulant fever became a recognized problem, it was difficult indeed to convince even the most open-minded of the danger of human infection. Undulant fever was considered a rare, if not a non-existent disease in Western Canada, while the cattle disease was supposed to be rampant.

Before suggesting an extensive program in connection with the testing of dairy herds, which we realized would be opposed by many owners, it was deemed advisable to make some attempt to determine the incidence of the human infection, and with this in view arrangements were made with the Department of Pathology at the University to have all Wassermann bloods kept over that they might also be tested for undulant fever. This work commenced in January, 1931, and was carried on until the end of 1939, during which time 12,351 samples were tested, of which 236 (or 1.91 per cent) were positive, and 300 (or 2.43 per cent) considered as suspicious. When preliminary results were made known in 1933, and it was realized that undulant fever was not a rarity, little difficulty was experienced in making plans for the testing of dairy cows. At the same time, physicians became interested in the matter and commenced sending blood samples from patients suspected of having the disease; and since that time 1022 such

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samples have been tested, 67 (or 6.5 per cent) having been found positive, and 48 (or 4.7 per cent) suspicious.

For the laboratory diagnosis of undulant fever both in man and in cattle, the agglutination test is universally employed, and we have used serum dilutions of 1/25, 1/50, 1/100 and 1/200. Sera showing complete agglutination in dilutions up to 1/100, and a partial reaction in 1/200, are considered positive; while those showing a complete reaction in 1/50, with partial agglutination in higher dilutions, are classified as suspicious. The plate, or rapid, agglutination test is also done on all sera giving either partial or complete reactions by the tube method. It would seem reasonably safe to conclude that individuals giving a suspicious result had been at one time infected with *Br. abortus,* since very few people in Western Canada harbor natural agglutinins for the organism. This fact has been determined through the testing of blood samples in dilutions of 1/10, and although 5150 such samples have been tested, but 36 (or 0.69 per cent) have shown a reaction in this dilution but no higher. Accepting that these partial reactions indicate infection, it means that of the 12,351 blood samples tested, 4.34 per cent were from people who had suffered from undulant fever, or at least had been infected by the causative agent.

In January 1933 systematic testing of dairy herds was begun, and although in that year only 2182 samples were examined the results obtained changed our ideas of the incidence of the disease in lower animals. It was found that of those tested but 7.5 per cent were affected. Since 1933, until the end of 1939, 40,184 tests have been done, and 5.68 per cent found to be positive. The percentage of infected animals located has decreased each year until 1939, when of 3786 animals tested only 104 (or 2.74 per cent) were positive. The decided reduction in the percentage of reactors is perhaps due to the annual testing of dairy herds in certain districts where such is compulsory before milk may be offered for sale. It is also true, however, that stockowners are now aware of the danger of harboring infected animals, and seldom is it done knowingly. The testing has been done on dairy herds supplying raw milk to towns and villages throughout the province, and should give a true conception of the incidence of the disease.

To make a comparison of the prevalence of the cattle disease with that of undulant fever in humans as determined by the testing of Wassermann blood samples may be open to criticism, but they are comparable in that both groups of samples were taken at random and not where the disease was suspected. The humans, of course, were not healthy individuals and the chance of securing positives might be greater than if the samples were collected from people not requiring medical attention. On the other hand, most of these samples were collected from city residents who had no contact with diseased animals; neither were they exposed to infection through the milk supply because of compulsory pasteurization. As a matter of fact, it was found that although relatively few samples were collected from rural dwellers, the majority of infections occurred in this group.

If it be true that the most common source of the human infection is direct

contact with diseased animals, or the consumption of infected milk, the results obtained would suggest that man is quite susceptible to *Br. abortus,* the incidence in man being only slightly lower than in cattle, since of 40,184 cattle tested only 5.68 per cent were diseased, while of the 12,351 humans tested 4.34 per cent were found to have been infected.

Whether or not this comparison is justified, there appears to be a direct relationship between the reduced incidence of the disease in cattle and that in man. As just mentioned, the average percentage of infected cows located from 1933 until 1939 was 5.68, while during the last two years, 1938 and 1939, this was reduced to 2.68. In the same periods, the percentage of infected humans located has fallen from 4.34 to 2.11. I am here considering partial reactions as an indication of the disease.

The significance of partial reactions may be difficult to determine, particularly when the symptoms presented by the patient are ill-defined. That some information might be secured in this connection, a number of experimental animals were inoculated with live cultures of *Br. abortus,* and a like number given suspensions of the organism which had been destroyed by heating. Agglutination tests conducted periodically showed that those receiving live organism reacted positively in high dilutions, in some instances for over a year. The titre of sera from animals inoculated wth dead cultures was at first quite comparable to those in the other group, but rapidly fell, and in some cases completely disappeared within a few months' time. At the end of the experiment, animals which had received the live organism were destroyed and examined for the presence of *Br. abortus,* when it was found that those giving even a partial reaction usually harbored the organism. If these results apply to human infections, a positive or partial result suggests active infection.

From a public health standpoint, the mere locating of infected animals by serological tests seemed insufficient, and it was therefore decided to make an effort to determine the percentage of reacting animals which actually shed the organism in their milk, thus constituting a true danger to humans. With this in view, the milk of 60 positive-reacting animals was cultured and examined for the presence of *Br. abortus,* and in cases where negative results were first secured, a second, and, in some instances, a third examination was made. *Br. abortus* was ultimately isolated from 70 per cent of these animals.

Although it was quite understood that the organism would survive in milk long enough to infect those consuming it, longevity tests were carried out with milk kept under different conditions. It has been found that in sterilized milk, *Br. abortus* will survive for at least eighteen months when kept at icebox temperature; and at room temperature in the dark the organism has been recovered after ten months.

The possibility of infections taking place through the consumption of butter produced with cream from infected cows has also received attention, and we find some strains will survive for at least thirteen months in butter containing no salt; and in that having a salt content of 2.1 per cent certain strains will be viable after six months. From creamery butter inoculated with *Br. abortus,* the

organism was isolated seven months later. This type of butter is supposed to contain 1.7 per cent salt. The possibility of butter actually harboring *Br. abortus* is perhaps remote, however. All creamery butter is made from pasteurized cream and can be eliminated as a source of danger. Farm or dairy butter, if produced from fresh cream, may be a possible source of infection; but if the cream is allowed to sour before the butter is made, as is usually the case, it would appear that the chance of *Br. abortus* surviving is small. We find that when sterile milk is inoculated with *Br. abortus* and *Streptococcus lacticus* it is impossible to secure cultures of the abortion organism after three to five days, while the same strains were recovered from milk which had not been inoculated with *Streptococcus lacticus* eighteen months later.

During the early years of this work, when undulant fever cases were located an effort was made to trace the source of infection, and with but few exceptions it was shown that the individual in question had consumed raw milk from infected cows or had been in direct contact with diseased animals. In one instance where three cases developed in a small town, it was found that these people were securing milk from a herd of ten cows, six of which were suffering from contagious abortion. In another case which developed on a farm, nine out of eleven cows were infected. In an outbreak in another section of the province, where four or five individuals were concerned, we showed the dairy herd to be highly infected. The source of infection of a woman who was in a rural hospital being treated for some other ailment was readily traced to the herd supplying the hospital with raw milk, where about 50 per cent of the cows reacted. Another striking case should perhaps be recited, where three members of a family became infected a short time after two cows had been introduced into the herd. A fourth member of this family at the time gave a suspicious reaction, while the hired man was also found to be infected. The newly purchased animals were suffering from the disease, and further investigation disclosed the fact that they had been previously tested and when found to be infected were sold to the unsuspecting buyer.

## CONTROL MEASURES

As a means of solving the undulant fever problem, too often we hear advocated the pasteurization of the milk supply. This is sidestepping the issue. That pasteurization should be practised whenever possible there is no doubt, but it should not be made use of in an attempt to render milk from diseased cows fit for human consumption. Unfortunately this has been the tendency in Western Canada in municipalities where pasteurization by-laws are in force. It is true that cities having such by-laws require that the cows be tested for tuberculosis, but for some unknown reason the testing of the same animals for contagious abortion is not considered. The first essential in connection with a safe and satisfactory milk supply is, of course, that the animals be free from disease, but in spite of this fact contagious abortion, a disease readily recognized by testing and one known to affect man, has gone unheeded in many parts. It is not only the presence of the undulant fever organism in the milk that renders an

infected cow objectionable as a dairy animal, but the susceptibility of such cows to secondary infections because of chronic tissue changes of the udder due to *Br. abortus*.

Undulant fever is a disease where preventive medicine can be highly effective, and its prevention should be carried out along two lines: the testing of dairy herds, with the elimination of reacting animals, together with the pasteurization of milk whenever possible. The testing of dairy cows is not the arduous task that it may appear, nor is the cost prohibitive. In Saskatchewan, the Public Health Act was amended in 1936, making it possible for the councils of towns and villages to pass a by-law making it compulsory to test all dairy herds supplying raw milk. Since that time 120 towns and villages have made use of the by-law and find little difficulty in its enforcement. Practising veterinary surgeons collect the blood samples and apply an ear tag on each animal for identification purposes. The testing is done at the University, and the laboratory fee is taken care of by the Provincial Department of Agriculture. The veterinary surgeon's fee is paid by the cattle owner or by the town, depending upon the arrangements made.

In Western Canada compulsory pasteurization is now fairly general in the larger cities, but is not at all practical at rural points except where creameries are located, and it appears that creamery owners are not at all anxious to undertake this work. Pasteurization of milk on the dairy farm has been suggested, but this, I feel sure, would give a false sense of security as in many cases it would not be done properly nor even regularly.

From a public health aspect, undulant fever presents a problem of importance since the disease is one which may incapacitate the victim for a long period of time, and because of the fact that the most susceptible are mature individuals who are likely to have responsibilities and others depending upon them.

It is unfortunate but true that the stimulus necessary to have dairy cows tested is the development in a district of the disease in man.

# Engineering Features of Pasteurizing Plants and Equipment

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PASTEURIZATION, as defined in the "Regulations on Milk Pasteurization Plants" issued by the Ontario Department of Health, is the process of heating every particle of milk to a temperature of not less than 143°F., of holding it at such temperature for not less than thirty minutes, and of cooling it immediately thereafter to 50°F. or lower in a manner and with equipment and apparatus approved by the Department of Health. To the uninformed, this process appears to be relatively simple and straightforward. Only those who are familiar with the handling of milk for retail distribution can appreciate the problems involved. Because of the susceptibility of milk to bacterial contamination, at every step in the process problems are met which may defeat the primary object. In the attainment of this object—the distribution of safe and wholesome milk for domestic consumption—the principles of good engineering play no small part. This fact is recognized by many provincial, state and other municipal governing bodies, where the responsibility for the inspection and supervision of pasteurization plants is placed in the hands of the sanitary engineering divisions of the departments of health.

*Plan of Building Necessary*

Ontario regulations require that a plan and specifications be forwarded to the Department of Health for approval before construction work begins. In most small milk plants, all operations are performed on one floor. The next most popular type of construction is the one-storey building with a mezzanine. Both of these types permit economy of labour and time in handling milk. In the mezzanine type, gravity flow of the pasteurized milk is possible and thus at least one pumping, with accompanying machinery and piping, is eliminated.

In larger plants, buildings of two or more storeys may be used. In these plants, the manufacture of other milk products such as butter, cheese, condensed milk, milk powder, etc., is generally associated with the production of pasteurized milk.

The size of the building and the floor-space requirements will depend upon such factors as the daily output, the type of equipment installed, and the probability of future expansion of business. In the allocation of space to the different steps of the processing, the plant should be cut up as little as possible by partitions but separate rooms for certain processes are always necessary. The Ontario regulations require that separate rooms be provided for (a) pasteurizing, cooling and bottling operations; (b) washing and bactericidal treatment of containers

and miscellaneous equipment; and (c) cold storage. In addition, it is advisable to provide separate rooms for the boiler and for receiving the raw milk.

In larger plants, still further separation of the various steps in the processing is frequently made and additional rooms are provided for the handling of by-products.

*Arrangement of Rooms*

The rooms in the plant should be arranged so that the expenditure for machinery and labor may be a minimum. The bottle-washing room should be near the boiler and bottle-filling rooms. This arrangement reduces the amount of steam lost in its passage to the bottle-washing equipment, and permits ready removal of the cleansed bottles to the filling room. The location of the cold storage depends on various considerations, but if possible it should be so situated that the milk can go directly into it from the bottling room.

*Arrangement of Equipment and Machinery*

Equipment should be so arranged that it can be easily cleaned. Much time is saved by convenient arrangement and the cleaner is less likely to neglect the work.

Machinery should be so placed as to minimize labor requirements and to use space most economically. Another point in placing the machinery is the reduction to a minimum of conveyors, pumps, pipes and fittings. This applies not only to milk piping but also to water and steam piping. The course of the milk through the plant should be as direct as possible from the receiving room, through the various processing machines to the cold storage room. Mechanical conveyors should be used whenever labour and time can be saved; otherwise the extra expense incident to their use is not warranted. Long lengths of milk piping should be avoided since they cause extra labor and expense and tend to increase the loss of milk both from the adherence of milk to the sides of the pipes and from leaks at joints.

Proper arrangement of the milk piping is important. Inter-connections between piping carrying raw milk and that conveying pasteurized milk should not be permitted. Nor should any piping or equipment be used for both the raw and pasteurized milk. Such arrangements are extremely hazardous irrespective of the cleaning given between use.

The plant layout, arrangement of machinery, and size and type of building have an important bearing on the number of employees required. This relationship becomes more important as the size of the plant increases. In allocating floor space for the various operations, however, it is important that ample allowances be made. Overcrowded conditions are detrimental to the maintenance of the proper sanitary conditions which are essential for successful operation.

*Construction Materials*

Most of the ordinary building materials may be used in constructing milk plants. The main precaution to be observed is that the inside of the building is

waterproof and easily kept clean. The choice of materials will depend upon local conditions in different sections of the country and local building regulations. Materials in common use include concrete block, wood, brick, hollow tile, poured concrete and stone.

Floor construction is very important. The floor must be hard-surfaced to resist wear, waterproof, smooth, easily cleaned and well drained. Some form of concrete is generally used. It should have a coved base against all vertical walls to facilitate cleaning. Where there will be extra heavy wear, as from rolling cans, trucks, etc., over the floor, iron grids may be placed in the concrete with the tops flush with the top of the floor. Solid iron plates are often used instead of grids, but they are harder to anchor to the concrete. Consequently they become loose and collect milk and dirt under them, causing foul odours and insanitary conditions. In recent years, special types of concrete floors with mineral hardeners have been developed. These, however, are still quite expensive to install.

Good drainage is essential. The floor should slope not less than one-eighth of an inch per foot. Unless the room is very large, one central drain outlet per room will usually suffice. All outlets should be trapped to prevent sewer gas entering the plant.

*Wall and Ceiling Finish*

Wall and ceiling finish in the work rooms must be moisture-proof and washable. A perfectly smooth finish with rounded corners is preferable. Ordinary wall paints seldom are satisfactory for any length of time and the use of special paints or enamels is advisable. In some plants, good results have been obtained by using special water- and heat-resistant varnishes. Where finances permit, the wall surface may be of enamel-brick or tile. Prepared hard plaster is unsatisfactory for either walls or ceiling where there is much moisture. Where this type of finish is desired, cement plaster should be used rather than ordinary plaster. Where the wall construction is of concrete blocks, a satisfactory surface may be obtained by applying cement plaster directly to the surface of the blocks.

Some of the commercial wallboards give good service if kept well painted. Wood walls and ceilings are very common in small plants. They are quite satisfactory if they are so built that they are free from cracks and if they are kept well painted. Concrete extending 12 inches or more above the floor level will facilitate the cleaning operations, make the plant more sanitary, and protect the wood wall from water and consequent rotting.

*Water, Sewerage and Ventilation*

Large amounts of pure water are required for milk-plant operation. Where municipal supplies are not available, private supplies from wells or other sources should be free from contamination or should be adequately treated before their use in the milk plant is allowed.

An efficient sewer system is essential. Where municipal sewer connections

are not available, cesspools or septic tanks may be used. Where it is necessary to install a private sewage disposal plant, all clean water used for cooling or other purposes should be separated from the wash water to reduce the size of the treatment plant required.

A good ventilation system will greatly improve working conditions. Either natural ventilation by the use of skylights or vents through the ceiling and roof, or a fan, or both, have been used to advantage in many plants. Condensation problems during the cold weather, however, are frequently serious. The elimination of these troubles would appear to warrant further study and research with a view towards the development of less expensive methods for their control.

*Milk-Processing Equipment*

Because of the susceptibility of milk to contamination of various kinds, the processing equipment must comply with certain rigid standards. These requirements are concisely stated in the regulations of the Ontario Department of Health:

"The equipment and containers used in the handling, processing or storage of milk shall be so constructed and kept in repair as to facilitate cleaning and bactericidal treatment, and any surfaces of such equipment and containers with which milk comes in contact shall be of smooth non-corroded metal or vitreous material, free from accumulation of milk solids and other foreign substances, self-draining and readily accessible for cleaning, and every joint in such equipment or container shall be made flush with the surface or otherwise constructed so as to avoid seams."

In the past, tinned copper and tinplate were most commonly used for the lining of vats and holding tanks and for piping. Glass-lined vats are also in common use. During recent years, with the development of satisfactory methods for welding such material, the use of chrome-nickel steel and other nickel alloy metals has made rapid strides. "Stainless" steel has now a wide application and holds an important place in the construction of milk-processing equipment.

*High Temperature—Short Time Pasteurization*

During recent years, considerable research has been carried on by manufacturers and others in the use of higher temperatures for pasteurizing. The process is known as high temperature—short time pasteurization. It consists of heating the milk to 160°F. and holding it at this temperature for a short period, usually from fifteen to twenty seconds. This equipment is highly technical in construction and is economically feasible only in plants with a large output. It has been accepted by health authorities in some states but its use is not yet permitted in Ontario.

*Types of Holding Equipment*

The various types of equipment commonly used for pasteurizing milk by the "holding" method are as follows:

1. The vat types in which the milk is heated to pasteurizing temperature while being mechanically agitated or stirred and is held at such temperature in the same vat for the required time. These include coil, spray and water jacketted vats.

2. The continuous flow types in which milk is held at pasteurizing temperature for thirty minutes while flowing through long tubes or while flowing through a rotating horizontal cylinder containing a helical-shaped division wall.

3. The pocket types in which a series of vats called "pockets" or holders are filled with milk preheated to pasteurizing temperature, held for thirty minutes and then emptied, the inlet and outlet valves being controlled automatically or by hand.

4. The in-bottle type in which milk is bottled and capped after pre-heating to a temperature of about 100°F., is carried on conveyors through a water bath in which the temperature of the milk is raised to 143°F. or more, and then through another hot water bath in which it is held for thirty minutes at pasteurizing temperature, and finally through cold water and ice-water baths where it is cooled.

## DEFECTS AND HOW CORRECTED

During the past fifteen years, investigators have disclosed many defects in design of the holding types of pasteurizers. In general, manufacturers have been able to alter their pasteurizers to correct these defects and now most of the pasteurizing equipment on the market is of satisfactory design.

The chief defects which have been found in pasteurizing equipment of the "holding" type are as follows: (1) inlet valves, (2) cold pockets, (3) outlet valves, (4) foam, (5) recording thermometers, and (6) control of heating medium.

### *Inlet Valves*

Practically all milk valves leak more or less. Where a number of pasteurizers are filled with milk through a pipe-line with a valve at each pasteurizer, raw milk may leak around the core of the valve into the pasteurizer during the holding period. This milk will not be held at the pasteurizing temperature for the full thirty minutes and disease-producing bacteria, if present in the raw milk, might get into the pasteurized milk without being rendered harmless. This danger is avoided in modern pasteurizers by cutting grooves in the inlet valve plugs or in the valve seat in such a manner that any leakage will run to waste. Leak protector inlet valves should be so installed that any milk wasted from them will not drip on the covers of the pasteurizers.

### *Cold Pockets*

In many pasteurizing installations, the outlet valve has been found at some distance from the pasteurizer itself; distances as great as thirty inches have been recorded. The milk in this length of pipe cannot be heated to the correct pasteurizing temperature. This improperly treated milk is the first to pass through all succeeding equipment and contamination of a considerable portion of the properly pasteurized milk is probable. Recent designs of pasteurizers and outlet valves eliminate this pocket entirely and on old equipment the pocket can be reduced to three or four inches.

### *Outlet Valves*

Just as leak protector inlet valves are necessary, so too is it important that the outlet valve be of similar design. In old installations, it was not uncommon

to find, on opening the outlet milk line connected with the pasteurizer just before the time for emptying the vat, that this piping was full or partly full of milk which had leaked past the outlet valve during the filling, heating and holding periods. This milk was not properly pasteurized and might cause trouble. Two designs of leak protector outlet valves are commonly used. One is a flush leak protector valve with sterilizing connections. In this valve, the seat is flush with the inner wall of the pasteurizer. It is designed to waste milk leaking past the valve seat and to sterilize the portion of the valve with which this unpasteurized milk comes in contact by mechanism actuated by turning the valve on or off. The second arrangement consists of a close-connected plug valve which grooves either in the plug or in the valve seat. In the water-jacketted pasteurizers of newer design, this valve is usually counter sunk in the water jacket and the opening from the face of this valve to the inner wall of the pasteurizer is enlarged so that the milk in this section will come within the influence of the agitating mechanism.

In Ontario additional protection against contamination from leaking valves is afforded by the requirement that all piping to and from holding vats be disconnected during the holding period and when not in actual use.

*Foam*

Tests have shown that foam on the surface of milk in a pasteurizer during pasteurization is cooler than the milk itself. There is a danger that disease-producing organisms, if present in the milk before pasteurization, may survive the pasteurizing process in the milk which goes to make up the foam. In most cases, foam is caused by air introduced in one or more of the following ways: (a) the level of the milk in the receiving vat may be allowed to get low while the pump is running permitting the pumping of air; (b) the joints in the pipe line between the receiving vat and the pump may not be tight, permitting air to enter; (c) the pump may be of poor design and incorporate air. Foam may also be produced by allowing milk to drop into the pasteurizer through a considerable distance. Some operators try to keep the foam hot by heating the air above the milk. The more practical way would appear to be to eliminate the foam by removing the cause.

*Recording Thermometers*

Faulty operation of pasteurizing equipment has often been attributed to an attempt to control the process by observing the recording thermometer. These are delicate instruments and are easily put out of adjustment. Earlier types had a range from 30°F. to 230°F. and could not be read accurately within three degrees or more. Many charts covered seven-day operating periods. Under these conditions, accurate heating and holding were not always obtained. To overcome this, health officials have required that every pasteurizer be equipped with an accurate indicating thermometer which is to be used in determining when the pasteurizing temperature has been reached and that every operator check the recording thermometer against this indicating thermometer daily. In

order that the recording thermometer charts may be more valuable as a record, they have also required that recording thermometers with twelve-hour charts and one-sixteenth inch spaces per degree at and near the pasteurizing temperature be used. These charts can be read much more accurately both for temperature and holding time. They should be changed and dated daily and kept on file as a record of plant operation.

*Control of Heating Medium*

The rate of heating the milk is important in protecting the flavor. Hot water is better than steam for heating and the temperature of the hot water should preferably not exceed 150°F. Automatic temperature control or indicating thermometers to show the temperature of the heating medium should be provided. At the end of the holding period, it is advisable to substitute cold water for hot in the circulating system. This will tend to prevent the formation of milk stone on the heating surfaces and will make it much easier to clean these surfaces.

*Milk Coolers*

Efficient and rapid cooling of the pasteurized milk to 50°F. or lower after holding is essential for successful operation. In the smaller dairies, tubular surface coolers are most generally used. These are usually built in two sections—well or city water being used in the upper section and ice-water, brine or direct expansion in the lower. In recent years the trend has been towards the use of smaller tubes since they have been found to be more efficient. Coolers with one-inch tubes are now commonly used. In order to protect the milk flowing over it from contamination, the cooler should be provided with suitable tight-fitting covers or enclosed in a small separate room free from flies and dust.

Where brine or direct expansion is used for cooling, careful operation is necessary to prevent the milk freezing on the cooler tubes. On being frozen, milk separates into solids and the fat emulsion is destroyed. When melted, the solids, the butterfat and the water do not return to their original state. They become a mixture of water, fat and solids that can hardly be called milk.

The use of "refrigerated" or "sweet" water for cooling milk has been increasingly adopted during recent years. By this system, milk can be cooled to 40°F. or lower without any possibility of freezing. This method is really a development of direct-expansion cooling with the water acting as a buffer between the milk-cooling load and the ice-machine. During a temporary shut-down of milk flowing over the cooler, the refrigerated water continues to circulate and no adjustments are needed to prevent freezing of the milk. At the same time, the ice-machine still has something to work on and dangers resultant from a sudden drop in back pressure are minimized.

In the larger plants, the use of "plate" coolers is becoming more general. These are enclosed units with the milk flowing in thin films along one side of a series of plates with the cooling medium flowing on the other side of the plate. In some plants, heat-exchange features are incorporated and the cold raw milk

is used to partially cool the pasteurized milk while it itself is partially heated on its way to the holding tanks.

*Bottlers and Cappers*

If the efficiency of the pasteurization process is not to be destroyed, it is important that the milk, after pasteurization, be protected against human contact. Mechanical bottling and capping equipment is therefore necessary. Bottlers should be so arranged that the milk will flow to them from the cooler without being exposed to dust, flies or dripping water.

Another feature of the bottling process, which might receive more attention, is the rise in temperature of the milk while this work is being done. Operating technique and mechanical equipment should be designed to keep these refrigeration losses at a minimum and there should be no delay in the transfer of the bottled milk to the cold-storage room.

*Cold-Storage Room*

The milk storage or refrigerator room must be well insulated to keep the milk always at a low temperature. To conserve refrigeration, the smaller the area of wall exposed to outdoor temperatures the better. Usually at least one wall will have to be an outside one, but the other three should be within the plant. The most common insulating materials are cork, mineral wool, cement and masonry.

In mechanical refrigeration, a recent development has been the more general use of unit coolers depending upon fan circulation. These installations do away with the unsightly damp overhead coils that make it so hard to maintain a clean, fresh, dry, cold-storage room. Storage temperatures below 40°F. are preferable.

*Bottle and Can Washing Equipment*

At many of the smaller plants, the turbine or motor-driven brush for washing bottles is still in use but the tendency is in favour of machine washing. Mechanical equipment of various capacities designed to meet the needs of all sizes of plants is on the market. Whatever method is used, the equipment must be efficiently operated if the bottles are to be clean and sterile.

Cans may be washed by hand; by a single jet with valves for cold water, hot water and steam, or by a can-washing machine. Whether hand or mechanical washing is employed, it is essential that the can be washed thoroughly, sterilized and dried. The return of a dry, sterile can to the producer has an important bearing on the quality of the raw milk being delivered at the plant.

*Boiler*

Whatever the size of the plant, boilers of proper capacity are required. Even though an undersized boiler will produce enough steam to do the required work, the extra time and labor required will more than offset the additional cost of the larger boiler. In addition, a forced boiler wears out quickly. Then, too, processing operations are apt to be rushed and the temperature of the water used

will often be below that necessary for thorough work. The boiler should be large enough not only to supply the present needs but also to take care of any increase in production for the next few years. Proper insulation will save a large percentage of the heat which would otherwise be lost by radiation.

*Efficient Operation Essential*

In conclusion, it cannot be too strongly emphasized that the successful operation of a pasteurizing plant requires much more than the possession of a well planned and constructed building equipped with modern machinery of approved design. The most important single factor affecting the operation of a plant is the operating personnel. The protection to the public health implied in the term "pasteurized" cannot be obtained without constant supervision, intelligent operation of pasteurizing equipment, and conscientious attention to all the various details of the cleansing and sterilization of processing equipment and containers.

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## "I'LL TAKE MINE PASTEURIZED!"

"THE numerous examples of serious outbreaks in the past seem ample proof of the medical authorities' contention that milk is an attractive range for homesteading by many types of malignant germs, and particularly those of the streptococcus family. For that reason, since milk is most universally used for human food, it becomes necessary to maintain strict regulation and supervision of its production and distribution. Such regulations quite often encounter bitter opposition from the champions of individual liberty. I have on my desk, for instance, a copy of an editorial which attacks a proposed regulation for Middletown which would ban the citizens of that municipality from bringing in raw milk, even for their own consumption. . . .

"Well, now let's take a look at all sides to this question. I'll match my enthusiasm for individual liberty against the Middletown editor's any time. And I'm just as opposed to unwarranted governmental interference with individual freedom as any man in this country. But I put the emphasis on 'unwarranted'. Past experience with epidemics of disease traced to infected raw milk gives considerable warrant for limiting the distribution of raw milk. For you see it has always been the policy of government in America to curb the individual when the exercise of his individual 'rights' interfered with the rights of his fellow citizens. That's why you can't park in front of a fire hydrant. *There might be a fire!* You see, government protection of the rights of all at the expense of the individual's unlimited freedom enters the field of possible damage to others as well as actual. That's the way it is with raw milk. It may be all right. But the government's regulations concerning it are based on the fact that past experience warrants the assumption that it may be all wrong!

"I used to be a very sincere defender of individual liberty as it affects raw milk. But I had to face facts. The rest of my former colleagues will have to face them sooner or later, also. Heating milk to a temperature of 143 to 145 degrees and holding it there for a period of 30 minutes, isn't too difficult. In the face of milk-borne epidemics in the state from 1917 to 1938 which affected the health of 8,382 people and involved 1,203 cases of typhoid, 123 cases of diphtheria, 1,442 cases of scarlet fever, 4,452 cases of septic sore throat, 311 cases of dysentry, 11 cases of polio and 840 cases of gastroenteritis, I'll take mine pasteurized!"—*Condensed from an editorial in the* Endicott (*N.Y.*) Times, *January 4, 1941, and reprinted in* Health News (*New York State Department of Health*), *April 1, 1940.*

# Progress in Pasteurization in Ontario*

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FOR a number of years the trend towards increased pasteurization of milk supplies has been marked throughout the world. The proportion of the milk supply so protected has risen steadily, due to voluntary methods as well as to compulsory legislation. In the Province of Ontario, action was taken by the Legislature in 1938. An amendment to the Public Health Act was passed making pasteurization compulsory. In the interval since this was adopted much progress has been made to extend this safeguard to the largest possible number of citizens.

*Legislation in Ontario*

The legislation passed in Ontario was an amendment to the Public Health Act rather than a special measure. The clauses of the amendment are unique in that pasteurization is made compulsory in all cities and towns irrespective of the population. In addition, provision is made for making the act applicable, by order-in-council, to any other area recommended by the Minister of Health. Attention is directed to the fact that the prohibition in this clause refers to "selling, offering for sale and to delivering." "Milk" and "pasteurization" are defined.

Another important feature of this legislation is the requirement that all milk must be pasteurized in plants which have been approved by the Provincial Department of Health. For this purpose a certificate of approval is issued. Provision has been made for the adoption of regulations on pasteurization plants. The act came into force on October 1, 1938.

The clauses of the Public Health Act dealing with this are as follows:

(*1*) *Definition of terms* (*Section 1*)

"Milk" shall include the whole milk and such products of milk as are supplied, processed, distributed or sold in any form other than butter or cheese.

*1938, c.30, s.2.*

"Pasteurization" shall mean the process of heating every particle of milk to a temperature of not less than 143 degrees Fahrenheit, of holding it at such temperature for not less than thirty minutes, and of cooling it immediately thereafter to 50 degrees Fahrenheit or lower, and "pasteurized" shall have a corresponding meaning.

*1938, c.30, s.2.*

(*2*) *Authority to pass regulations* (*Section 5*)

Regulating the pasteurization of milk and prescribing the form and the conditions under which a certificate of approval may be issued to any plant in which milk is pasteurized, or in which milk products are prepared.

*1938, c.30, s.3.*

**Presented at the twenty-ninth annual meeting of the Canadian Public Health Association, Winnipeg, Man., September 1940.*

(3) *The main part of the amendment (Section 95a)*

(1) No person shall sell, offer for sale, or deliver in any city or town, or in any other municipality or other area to which by order-in-council made upon the recommendation of the Minister this section is made applicable, milk which has not been pasteurized in a pasteurization plant to which the Department has issued a certificate of approval in the prescribed form.

(2) This section shall not apply to milk brought into any such city, town, municipality or area by the producer and sold by wholesale to a distributor, nor to products of milk prepared in a plant and by methods approved by the Department.

(3) Any medical officer of health, sanitary inspector and any person authorized by a medical officer of health may, without laying any information or obtaining any warrant, seize and remove any milk sold, offered for sale or delivered, including any container in which such milk is found, for the purpose of causing an analysis of such milk to be made.

(4) Any person who contravenes any of the provisions of this section shall incur a penalty of not less than $25 nor more than $500.

*1938, c.30, s.8.*

This measure constituted an important advance in milk control in Ontario. It is believed to be the first electoral area of its size in the world to make pasteurization compulsory. One of the Scandinavian countries adopted a somewhat similar enactment to take effect about a year later. To visualize the extent of this program and to measure the progress in the interval it is necessary to outline the conditions prior to the legislation, as well as some of the steps which have been taken subsequently.

*Conditions Prior to the Legislation*

In the Province of Ontario the conditions prior to this legislation were somewhat similar to those in some of the other provinces. Much of the responsibility for milk control rested with the municipalities, while the province acted in an advisory capacity. A Milk Control Act had been passed in 1934, but this was devoted to price regulation chiefly. Licences were required for all distributors of either raw or pasteurized milk. Sanitary standards were not a part of this. In 1936 an amendment was adopted to the Control Act setting standards for both raw milk dairies and for pasteurizing plants. Inspection was made by the Department of Health, but administrative control was vested in the Milk Control Board, a branch of the Department of Agriculture. While this latter step was a definite advance over former conditions it was inadequate. When compulsory pasteurization was adopted, complete control over all pasteurizing plants passed to the Department of Health, and each plant was required to obtain a yearly certificate of approval. No charge is made either for the inspection or for the certificate.

*Activities of Local Municipalities*

Local municipalities, through their boards of health and councils, have been involved to a considerable extent in the milk question. They still have a definite responsibility, but the province has assumed a much wider activity. The Milk and Cream Act had been in force in Ontario since about 1913. This was permissive legislation and gave authority to the municipalities to exercise supervision over milk production and distribution. They had the

right to make pasteurization compulsory, but to do so the council was expected to pass a by-law. Such a procedure had many disadvantages, and the progress made was limited.

In spite of the opportunity given to local municipalities by the Milk and Cream Act there was much to be desired. Only fifty municipalities out of a total of over 800 had made pasteurization compulsory by law, but in fifteen others the total milk supply was pasteurized, without aid of special legislation. Twelve of the twenty-seven cities had complete pasteurization. In most of the others a substantial proportion of the milk sold was protected in this way. In 198 municipalities some pasteurization was conducted. Many of these were villages and townships. In addition to the twenty-seven cities in the province there are 147 towns. The other municipalities are incorporated as villages and townships. Many townships are urban in character although classed as rural areas. These figures indicate only a moderate advance in pasteurization under local administration.

A further defect in this program under municipal control is seen in the lack of uniformity in standards for pasteurizing plants, and for raw milk dairies. Each municipality set up its own requirement and in view of the technical problems involved it was scarcely to be expected that satisfactory results would be secured. This was particularly noticeable in the smaller centres where trained personnel could not be retained.

*What the Legislation Did*

The pasteurization legislation in Ontario has accomplished two important advances. Firstly, it removed from local centres the controversy of deciding for or against pasteurization, a decision which formerly was made by bodies untrained in public health matters. Secondly, it created uniform requirements for all pasteurizing plants in the province, together with supervision over these by the Provincial Department of Health. Both of these steps are essential in any active milk control program.

This legislation has now been in operation for two years. Some of the progress made may be seen from statistics. Twenty-seven cities and 147 towns automatically came under the act. In addition to this, seven different orders-in-council have been passed designating villages, townships and areas for compulsory pasteurization. All villages and police villages of 500 population or over are now under the act, while many smaller communities are likewise included. Many rural areas have also been designated. These include 154 townships, and parts of thirty-seven other townships.

Summer resort areas in Ontario created a problem. These are numerous, and in the summer, large populations frequent these territories. In the winter it is difficult to maintain delivery to these sparsely settled areas. To meet this situation these places were brought under the act for the summer months only (June 1st to October 1st). While some difficulties are encountered it has given protection to summer vacationists. Sixty-three whole townships and twenty-four part townships are involved.

It is now estimated that over 98 per cent of all milk sold in Ontario for consumption in fluid form is pasteurized. This is processed in 813 plants, a figure probably more than double that for the remainder of the Dominion.

*Control of Diseases*

When a number of factors are involved in the control of those diseases which may be milk-borne it is not possible to determine accurately the part which milk plays, although it is known to be an important factor. Some statistics for the Province of Ontario for the year 1939 are of interest. These are the latest available and at that time not all the areas now under the act were included for the entire year. The cases of undulant fever in 1939 were reduced by about 45 per cent. The typhoid fever death rate was lowered approximately 50 per cent. Paratyphoid showed a somewhat smaller decrease. Infant mortality was reduced substantially.

*Progress in the Dairies*

Progress in this program has not been confined merely to increasing the extent of pasteurization. An important contribution has been made in bringing the pasteurizing plants to a uniform standard. The regulations are set out in detail, and all plants are examined periodically by engineers of the Department. Many changes have been necessary, and considerable expense involved for the dairies. This has been an important step in safeguarding the milk consumer. Now, all reasonable safeguards are required in the dairies, and when this is supplemented by such laboratory tests as plate counts, colon content and phosphatase, close supervision is assured.

*Activities for Local Boards*

In the program adopted in Ontario full co-operation and assistance are expected from local boards of health. Provincial standards have been adopted, but these are in the nature of minimum requirements. There is nothing to prohibit any municipality from setting higher standards if these are felt desirable. Up to the present there has been little desire to depart from Provincial requirements. In addition to this the local board is expected to maintain some routine supervision over these plants, and to send samples to the laboratory regularly. There is a close co-operation between the Department and the local boards.

The activities of the province are confined chiefly to the processing plants. It has not been feasible to extend supervision to the producers' premises although requests have been made for this. It remains for the local boards to inspect the farms and to check on the quality of the milk reaching the dairies.

The milk control program for the province has now been extended almost as far as it is feasible to carry it. All areas of appreciable size have been included, and rural areas have been supplied where transportation could be

arranged. It is gratifying to have so many rural townships under the act, and being supplied with pasteurized milk. Plants at convenient centres have been able to cover substantial areas, where the populations are too small to warrant the cost of equipment for each community. Acceptance of this new condition by the public has been favourable, and in many of the smaller centres milk consumption has risen substantially when the pasteurized milk has been made available.

*Steps Leading to Compulsory Pasteurization*

A program of the magnitude undertaken in Ontario required much preparation. For several years the Department of Health had made careful and comprehensive studies of milk-borne diseases and the accomplishments of pasteurization. There was no dearth of evidence to show that pasteurization was the only feasible procedure for safeguarding the milk consumer under the conditions which must be expected in commercial distribution. Investigations and data were available to show that pasteurization did not have any measurable injurious effect on the nutritional value of the milk. It is desirable to have this information available in convenient form and in lay language as a guide to those who must make the final decision.

It can scarcely be hoped that complete unanimity of opinion would ever be obtained in a problem of this nature. Objections have been raised, to a limited extent by medical practitioners, but chiefly by laymen who did not have any opportunity to secure proper information. Different arguments have been advanced, some of which have been entirely disproven by technical research. Others involved such non-technical topics as increased costs, monopoly of sales, liberty in the choice of foods, loss of business, and similar matters. In spite of these statements there has been little public support for those who attempt to introduce such claims as opposed to the many advantages proved to be derived from pasteurization. From the program in Ontario the feasibility of applying pasteurization to both large and small municipalities, urban and rural, has been demonstrated. The need for this protection has always been recognized.

# The Phosphatase Test

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QUITE recently there have appeared, both in England (1) (2) and in the United States (3), excellent reviews of the literature dealing with the phosphatase test, and hence it will suffice here to re-emphasize certain aspects only of the subject.

Kay and Graham first introduced a phosphatase test in 1933 (4) and two years later (5) the same authors published a much improved method for the test. The basis for the test is the fact that raw milk contains an enzyme, phosphatase, which is almost completely inactivated by pasteurization. This enzyme possesses the property of hydrolyzing certain esters of phosphoric acid. In particular, if the phosphoric ester, disodium phenyl phosphate, is mixed with milk containing phosphatase, the ester breaks down, under suitable conditions of temperature and pH and time, into phenol and sodium phosphate. The amount of phenol produced, which may be determined by suitable means, is a measure of the phosphatase content of the milk.

In their publication of 1935, Kay and Graham made certain claims regarding the sensitivity of the phosphatase test, namely that the test would reveal "(a) a temperature of 1½°F. below the minimum for pasteurization, or (b) heating (at 145°F.) for twenty instead of thirty minutes, or (c) admixture of 0.25 per cent of raw milk with properly pasteurized milk." Since then the test or some modification of it has been investigated on a large scale by workers in several countries, particularly in England, Canada and the United States, and it can be said, speaking generally, that the claims made by Kay and Graham have been substantiated.

While it is true that a need had been felt for a laboratory test for pasteurization, the extent of the need was not known until the test had been applied. For example, Kay and Graham reported in 1935 (5) that no less than one quarter of the "pasteurized" milk sold to the public and as much as half of the "pasteurized" milk supplied to school children was in fact either raw or underpasteurized. And again in 1937 Smith (6) reported that of 218 samples of Ontario milk labelled pasteurized, 12 per cent were improperly pasteurized as shown by the test. These results and others which might be cited have brought out clearly the false security which may lurk behind the label "pasteurized" and in addition have emphasized the need for continuous checking of the efficiency of pasteurization of milk and of milk products by a suitable laboratory test.

A good outcome of the application of the phosphatase test which might have been expected, and which has indeed followed, has been an improvement in the efficiency of pasteurization. It has been possible in many instances, by the appli-

cation of the test, to locate short-comings in pasteurization, whether due to mechanical defects or to human weakness. It is not to be wondered at, therefore, that the phosphatase test has been received with great interest, and even enthusiasm. Tiedman (7), in the introduction to a paper on the subject, has this to say: "It will not be surprising to encounter some skepticism on the part of those who have not had experience in the use of the test when we say that the millenium has come."

*The Scharer Modification*

During the eight years since its introduction the phosphatase test has undergone a number of modifications at the hands of different workers. It will suffice here to refer only to the modification due to Scharer (8). An essential difference between the Kay-Graham test and the Scharer test has to do with the method for the determination of phenol resulting from the hydrolysis of the phosphoric ester. For this purpose Kay and Graham use the reagent of Folin and Ciocalteu, whereas Scharer uses a more sensitive and a more specific reagent for phenol, viz. 2:6—dibromoquinone chloroimide. Just as with the original Kay-Graham test, so there are with the Scharer test two variants: a qualitative or field test, and an accurate laboratory test. Reports which have been published indicate that the laboratory test of both Kay and Graham and of Scharer, when properly carried out, give results of the same order of accuracy. Gilcreas (9) has reported the results of a study of Scharer's short test, in which eighteen laboratories collaborated. This study led in part to the following guarded recommendation: "That further studies be made in order that a suitable, precise and sensitive technique for field use in the control of pasteurization may be developed." On the other hand, Aschaffenburg and Neave (10) in Kay's laboratory have described a modification of Scharer's short test for which a degree of precision equal to that of the Kay-Graham laboratory test is claimed.

Whatever future developments there may be in connection with the phosphatase test, it would appear that at present there is available a test for pasteurization of milk which according to published reports can be successfully applied to milk pasteurized by the holder process at various temperatures or by the high-temperature short-time process and to various milk products, e.g. butter, cheese, ice cream, etc.

*Limitations of the Phosphatase Test*

It goes without saying that if reliable results are to be obtained, the phosphatase test must be carried out with care and intelligence. Attention must be paid to various possible pitfalls, against which warning is given in detailed descriptions of the test. There are, of course, obvious limitations. Raw milk, for example, may be present in amount below that which is detectable by the test. Properly pasteurized milk may be contaminated after pasteurization, a possibility which was demonstrated by Moffat and MacKay (11). The test may be in error due to the varying stability of phosphatase to heat. Some evidence has been brought

forward which suggests that the phosphatase in certain milks (6) (10) and in some milk products (12) (13) is more resistant to heat than that present in average milk. This question of conditions having to do with possible variations in the stability of phosphatase to heat could be of some importance and might warrant further study.

Finally, reference should be made to a question which is indirectly associated with the phosphatase test, namely the resistance of the tubercle bacillus to heat. Kay (2) has cited results (unpublished) which bear on this matter. Over a period of three years, 150 samples of commercial pasteurized milk showing a negative phosphatase test were examined by guinea-pig inoculation for the presence of tubercle organisms. In no instance was a positive guinea-pig test obtained. On the other hand, in what appears to be a careful piece of work, Sutherland (14) has reported that of 334 milks with a negative phosphatase test, twelve contained tubercle bacilli as shown by guinea-pig inoculation. It is quite probable that this result is due to other causes than the survival of the tubercle bacillus at 145°F. for thirty minutes. Nevertheless, it might well be worth while to reopen the question of conditions affecting the thermal death point of pathogenic bacteria in milk, a question which for the tubercle bacillus North and Park (15) seemed to have so completely answered.

## SUMMARY

During the eight years since its introduction the phosphatase test, or some modification of it, has been tried out on a large scale by workers in different countries. The results have substantiated the claim that the test is of great value in controlling the efficiency of pasteurization.

Some anomalous results which have been obtained with the phosphatase test have drawn attention to certain questions in connection with pasteurization which might be worthy of investigation or reinvestigation.

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# Survey of Milk Control, Including the Extent of Pasteurization, in Municipalities of Two Thousand Population in Canada

COMPILED BY THE MILK COMMITTEE
OF THE CANADIAN PUBLIC HEALTH ASSOCIATION

IN British Columbia nineteen municipalities, including all the major urban centres, forwarded reports to the Milk Committee. In none was it indicated that the entire milk supply was pasteurized. In Vancouver 79 per cent was recorded as pasteurized, in Victoria 50 per cent, in Burnaby 65 per cent, in Nelson 47 per cent, in New Westminster 40 per cent, and in North Vancouver 65 per cent. In these centres the number of dairies distributing raw milk greatly exceeded the number distributing pasteurized milk. Sixteen municipalities recorded the tuberculin testing of all dairy cattle. In three municipalities the testing of all dairy herds for contagious abortion was also reported. These findings, when compared with the survey made by the Milk Committee in 1938, show little change in regard to the extent of pasteurization.

ALBERTA. In Calgary 94 per cent of the milk was recorded as pasteurized, in Edmonton 77 per cent, in Lethbridge 53 per cent, in Drumheller 53 per cent, and in Red Deer 95 per cent. In each of these municipalities tuberculin testing of all dairy cattle is required. In none is contagious-abortion testing carried out completely.

SASKATCHEWAN. In Saskatchewan eleven municipalities completed reports for the Committee. Saskatoon and North Battleford recorded 100 per cent of the milk supplies as being pasteurized, Regina 97 per cent, Prince Albert 96 per cent, and Moose Jaw 95 per cent. An increasing amount of milk is being pasteurized in Yorkton (80 per cent), Weyburn (60 per cent), Swift Current (60 per cent), and Estevan (41 per cent). In all the municipalities mentioned tuberculin testing of all cattle is required. In four, contagious-abortion testing of all dairy cattle is conducted.

MANITOBA. Reports were received from eight municipalities in Manitoba. The percentage of milk pasteurized in Winnipeg is now 88, a significant increase over the amount pasteurized in 1938. The percentages for other municipalities are: Portage La Prairie 68, Dauphin 50, and The Pas 33. In St. Boniface pasteurization was introduced in 1938 and now 65 per cent of the supply is pasteurized. In four of the municipalities all cattle are tuberculin tested. Only in The Pas is testing being conducted for the occurrence of contagious abortion.

ONTARIO. The data for Ontario are of special interest. Reports were received from one hundred and one municipalities. In these, with but four exceptions, 100 per cent of the milk is now pasteurized. Tuberculin testing of all

dairy cattle is conducted in fifty-six municipalities and in seventeen municipalities testing for contagious abortion applies to all herds.

From the table can be traced the development of compulsory pasteurization in Ontario. Of outstanding interest is the fact that pasteurization now applies to all milk supplies in Ontario and that it has been demonstrated that it is practicable to provide residents of small urban and many semi-rural areas with pasteurized milk.

QUEBEC. Reports were received from seventy-four municipalities in Quebec. Forty-eight recorded the distribution of some pasteurized milk. In 1938 only thirty-two municipalities reported to the Committee that some pasteurization was being conducted. Pasteurization is largely confined to the milk supplies of the city of Montreal and the adjacent municipalities. Practically 100 per cent of the milk is pasteurized in the City of Montreal. Outremont (1939), Montreal West (1939), Westmount (1937), and Verdun (1938), all adjoining Montreal, have achieved 100 per cent pasteurization. Another city with 100 per cent pasteurization is St. Lambert, which was one of the first municipalities in Quebec to introduce compulsory pasteurization (1920). Tuberculin testing of cattle is required in all dairy herds in sixty-seven municipalities. As elsewhere in Canada, testing of cattle for contagious abortion is conducted in only a few municipalities.

NEW BRUNSWICK. In the report for New Brunswick are found, with but one exception, all the larger centres of population. In none is compulsory pasteurization required. In the city of Saint John 65 per cent of the milk is pasteurized; in Fredericton, only 25 per cent. In all the municipalities tuberculin testing of cattle is carried out.

NOVA SCOTIA. Progress in the safeguarding of milk by pasteurization is being made throughout Nova Scotia. In only three of the twenty urban centres reporting is no pasteurized milk being offered for sale. In the city of Halifax 96 per cent of the milk is now pasteurized; in Sydney, 75 per cent. Wolfville, not included in the survey, was the first community in Nova Scotia to achieve 100 per cent pasteurization. Tuberculin testing of all dairy cattle is conducted in six municipalities.

PRINCE EDWARD ISLAND. Seventy per cent of the milk supply of Charlottetown is pasteurized and tuberculin testing of all dairy cattle supplying milk for the city is conducted.

## TABLE I

MILK CONTROL IN CITIES AND TOWNS IN CANADA, 1939
Including the extent of pasteurization, volume of milk distributed, and supervision of herds in municipalities having a population of more than 2,000.

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *British Columbia* | | | | | | | | | | | | |
| Burnaby | 25,564 | Yes | Yes | 70% | None | No | | 5 | 16 | 10,000 qts. | 65 | — |
| Chilliwack | 2,461 | No | Yes | Complete | Part | No | | 0 | 4 | — | 0 | Annually |
| Cranbrook | 3,067 | Yes | Yes | Complete | Complete | No | | 0 | 6 | 1,200 qts. | 0 | Monthly |
| Cumberland | 2,371 | Yes | Yes | Complete | None | No | | 0 | 4 | — | 0 | Annually |
| Fernie | 2,732 | Yes | Yes | Complete | None | No | | 0 | 9 | 900 qts. | 0 | Annually |
| Kamloops | 6,167 | Yes | Yes | Complete | None | No | | 0 | 22 | — | 0 | — |
| Ladysmith | 1,443 | Yes | Yes | Complete | Complete | No | | 0 | 5 | — | 0 | Monthly |
| Nanaimo | 6,745 | Yes | Yes | Complete | Complete | No | | 1 | 30 | 10,000 qts. | 10 | Monthly |
| Nelson | 5,992 | Yes | Yes | Complete | None | No | | 2 | 15 | 2,052 qts. | 47 | Annually |
| New Westminster | 17,524 | Yes | Yes | Complete | None | No | | 4 | 28 | 8,000 qts. | 40 | Monthly |
| North Vancouver | 8,510 | Yes | Yes | Complete | None | No | | 4 | 5 | 4,800 qts. | 65 | Monthly |
| Port Alberni | 2,356 | Yes | Yes | Part | None | No | | 0 | 12 | — | 0 | Semi-annually |
| Prince George | 2,479 | No | Yes | Complete | None | No | | 0 | 2 | 400 qts. | 0 | Semi-annually |
| Prince Rupert | 6,350 | — | Yes | Complete | None | No | | 3 | — | — | — | Annually |
| Revelstoke | 2,736 | Yes | Yes | Complete | 50% | No | | 0 | 5 | 800 qts. | 0 | Annually |
| Rossland | 2,848 | Yes | Yes | — | — | No | | 1 | — | — | 0 | Annually |
| Trail | 7,573 | Yes | Yes | Complete | None | No | | 1 | 11 | — | 35 | Annually |
| Vancouver | 246,593 | Yes | Yes | Complete | Part | No | | 20 | 37 | 84,000 qts. | 79 | Weekly |
| Victoria | 39,082 | Yes | Yes | Complete | 10% | No | | 5 | 125 | 10,400 qts. | 50 | Annually |
| *Alberta* | | | | | | | | | | | | |
| Calgary | 83,761 | Yes | Yes | Complete | Part | No | | 4 | 13 | 25,386 qts. | 94 | — |
| Drumheller | 2,987 | Yes | Yes | Complete | None | No | | 2 | 4 | 1,700 qts. | 53 | Quarterly |
| Edmonton | 79,197 | Yes | Yes | Complete | 23% | No | | 6 | 43 | 37,481 qts. | 77 | Quarterly |
| Lethbridge | 13,489 | Yes | Yes | Complete | Part | No | | 2 | 6 | 3,350 qts. | 53 | — |
| Red Deer | 2,344 | Yes | Yes | Complete | 5% | No | | 2 | 2 | 900 qts. | 95 | Quarterly |
| *Saskatchewan* | | | | | | | | | | | | |
| Estevan | 2,936 | Yes | Yes | Complete | Complete | No | | 1 | 3 | 500 qts. | 41 | Monthly |
| Kamsack | 2,087 | Yes | Yes | Complete | None | No | | 0 | 4 | — | — | Semi-annually |
| Melville | 3,891 | Yes | Yes | Complete | Complete | No | | 0 | 30 | 800 qts. | 0 | Monthly |
| Moose Jaw | 21,299 | Yes | Yes | Complete | Complete | Yes* | 1937 | 3 | 3 | 8,024 qts. | 95 | Monthly |
| North Battleford | 5,986 | Yes | Yes | Complete | Complete | Yes | 1936 | 3 | 0 | 1,591 qts. | 100 | Monthly |
| Prince Albert | 9,905 | Yes | Yes | Complete | Part | No | | 3 | 1 | 3,954 qts. | 96 | Bi-monthly |
| Regina | 53,209 | Yes | Yes | Complete | None | No | | 7 | 5 | 14,190 qts. | 97 | Bi-monthly |
| Saskatoon | 43,291 | Yes | Yes | Complete | None | Yes | 1922 | 4 | 0 | 14,868 qts. | 100 | Daily |
| Swift Current | 5,296 | Yes | Yes | Complete | — | No | | 2 | 3 | 1,050 qts. | 60 | Quarterly |
| Weyburn | 5,002 | Yes | Yes | Complete | None | No | | 3 | 4 | — | 60 | Periodically |
| Yorkton | 5,027 | Yes | Yes | Complete | None | No | | 3 | 1 | 1,800 qts. | 80 | Semi-annually |

TABLE 1.—*Continued.*

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Manitoba* | | | | | | | | | | | | |
| Brandon | 17,082 | Yes | Yes | — | — | No | | 2 | 43 | 4,440 qts. | 42 | Monthly |
| Dauphin | 3,971 | Yes | Yes | Complete | None | No | | 1 | 3 | 1,300 qts. | 50 | Annually |
| Portage la Prairie | 6,597 | Yes | Yes | Complete | None | No | | 2 | 4 | 1,162 qts. | 68 | Monthly |
| St. Boniface | 16,305 | Yes | Yes | Complete | None | No | | 7 | 14 | 3,440 qts. | 65 | Monthly |
| Selkirk | 4,486 | Yes | Yes | Complete | None | No | | 0 | 6 | — | — | Semi-annually |
| The Pas | 4,030 | Yes | Yes | Part | Part | No | | 1 | 3 | 887 qts. | 33 | Bi-monthly |
| Transcona | 5,747 | Yes | Yes | 5% | None | No | | 3 | 35 | — | — | Semi-annually |
| Winnipeg | 218,785 | Yes | Yes | 12% | None | No | | 10 | 48 | 72,000 qts. | 88 | Monthly |
| *Ontario* | | | | | | | | | | | | |
| Almonte | 2,415 | No | Yes | Complete | Complete | Yes | 1936 | 2 | 0 | 600 qts. | 100 | Quarterly |
| Arnprior | 4,023 | Yes | Yes | Complete | None | Yes | 1938 | 3 | 0 | 1,100 qts. | 100 | Quarterly |
| Aurora | 2,587 | No | Yes | Complete | Complete | Yes | 1927 | 2 | 0 | 1,500 qts. | 100 | Weekly |
| Aylmer | 2,283 | No | No | Part | Part | Yes | 1938 | 2 | 0 | 750 qts. | 100 | Quarterly |
| Barrie | 7,776 | No | Yes | Complete | None | Yes | 1931 | 4 | 0 | 8,500 qts. | 100 | Frequently |
| Belleville | 13,790 | No | Yes | 30% | 25% | Yes | 1938 | 6 | 0 | 5,290 qts. | 100 | Periodically |
| Blind River | 2,805 | No | Yes | Part | None | Yes* | 1938 | 1 | Many | 500 qts. | 50 | Semi-annually |
| Bowmanville | 4,080 | No | No | Complete | None | Yes | 1938 | 3 | 0 | 1,275 qts. | 100 | Semi-annually |
| Bracebridge | 2,436 | Yes | Yes | Complete | Complete | Yes | 1938 | 2 | 0 | 672 qts. | 100 | Monthly |
| Brampton | 5,532 | No | No | Complete | 15% | Yes | 1938 | 4 | 0 | 1,871 qts. | 100 | Monthly |
| Brantford | 30,107 | Yes | Yes | 60% | None | Yes | 1920 | 7 | 0 | 9,000 qts. | 100 | Daily |
| Bridgeburg | 3,521 | No | Yes | Complete | Complete | Yes | 1938 | 6 | 0 | 2,400 qts. | 100 | Monthly |
| Brockville | 9,736 | Yes | Yes | Complete | 33% | Yes | 1938 | 6 | 0 | 4,200 qts. | 100 | Weekly |
| Burlington | 3,046 | Yes | Yes | Complete | Part | Yes | 1932 | 9 | 0 | 1,100 qts. | 100 | Quarterly |
| Campbellford | 2,744 | Yes | Yes | Complete | Part | Yes | 1933 | 3 | 0 | — | 100 | Annually |
| Carleton Place | 4,105 | Yes | Yes | Complete | Complete | Yes | 1935 | 2 | 0 | 1,300 qts. | 100 | Semi-annually |
| Chatham | 14,569 | Yes | Yes | 50% | None | Yes | 1938 | 6 | 0 | 5,170 qts. | 100 | Bi-monthly |
| Cobalt | 3,885 | Yes | Yes | Complete | None | Yes | 1938 | 2 | 0 | 500 qts. | 100 | Semi-annually |
| Cobourg | 5,834 | No | Yes | Complete | Part | Yes | 1938 | 4 | 0 | 1,900 qts. | 100 | Monthly |
| Cochrane | 3,963 | Yes | Yes | Complete | Complete | Yes | 1938 | 3 | 0 | 500 qts. | 100 | Bi-monthly |
| Collingwood | 5,809 | Yes | Yes | Complete | None | Yes | 1938 | 5 | 0 | — | 100 | Monthly |
| Copper Cliff | 3,173 | No | Yes | None | None | Yes | 1938 | 1 | 0 | 1,200 qts. | 100 | Quarterly |
| Cornwall | 11,126 | Yes | Yes | Complete | Part | Yes | 1930 | 10 | 0 | 5,000 qts. | 100 | Monthly |
| Dundas | 5,026 | No | Yes | 50% | None | Yes | 1918 | 2 | 0 | 1,450 qts. | 100 | Semi-annually |
| Elmira | 2,170 | No | Yes | Complete | 50% | Yes | 1938 | 3 | 0 | 400 qts. | 100 | Quarterly |
| Fergus | 2,594 | No | Yes | Part | Part | Yes | 1938 | 3 | 0 | 1,000 qts. | 100 | Monthly |
| Forest Hill | 5,207 | — | — | — | — | Yes | — | 23 | 0 | — | 100 | Quarterly |
| Fort Erie | 2,383 | No | No | Complete | 75% | Yes | 1936 | 6 | 0 | 2,400 qts. | 100 | Irregularly |

—Information not supplied. *Provincial law not accepted by town.

TABLE I.—*Continued.*

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ontario—Cont.* | | | | | | | | | | | | |
| Fort Francis | 5,470 | Yes | Yes | Complete | Complete | Yes | 1938 | 2 | 0 | 1,800 qts. | 100 | Weekly |
| Fort William | 26,277 | No | No | Complete | 3% | Yes | 1938 | 12 | 0 | 7,848 qts. | 100 | Monthly |
| Galt | 14,006 | Yes | Yes | Complete | 20% | Yes | 1938 | 5 | 0 | 6,700 qts. | 100 | Monthly |
| Gananoque | 3,592 | Yes | Yes | Complete | Complete | Yes | 1938 | 3 | 0 | 1,400 qts. | 100 | Monthly |
| Georgetown | 2,288 | No | Yes | Complete | Complete | Yes | 1938 | 2 | 0 | 1,000 qts. | 100 | Bi-monthly |
| Goderich | 4,491 | No | Yes | Part | Part | Yes | 1938 | 3 | 0 | 1,626 qts. | 100 | Monthly |
| Grimsby | 2,198 | No | Yes | Complete | Complete | Yes | 1938 | 2 | 0 | 950 qts. | 100 | Quarterly |
| Guelph | 21,075 | Yes | Yes | Complete | Complete | Yes | 1938 | 4 | 0 | 8,000 qts. | 100 | Quarterly |
| Hamilton | 155,547 | Yes | Yes | 95% | 12% | Yes | 1928 | 22 | 0 | 64,392 qts. | 100 | Bi-weekly |
| Hanover | 3,077 | No | Yes | 75% | 5% | Yes | 1938 | 2 | 0 | 900 qts. | 100 | Bi-monthly |
| Hawkesbury | 5,177 | No | Yes | Complete | Complete | Yes | 1938 | 2 | 0 | 1,000 qts. | 100 | Annually |
| Hespeler | 2,752 | No | Yes | Complete | None | Yes | 1938 | 5 | 0 | 1,600 qts. | 100 | Quarterly |
| Humberstone | 2,490 | No | Yes | 50% | None | Yes | 1938 | 3 | 0 | 915 qts. | 100 | Bi-monthly |
| Huntsville | 2,817 | No | Yes | 25% | None | Yes | 1938 | 2 | 0 | 2,400 qts. | 100 | Quarterly |
| Ingersoll | 5,233 | No | No | Part | None | Yes | 1938 | 2 | 0 | 1,680 qts. | 100 | Monthly |
| Kapuskasing | 3,819 | Yes | Yes | — | — | Yes | 1927 | 2 | 0 | 800 qts. | 100 | Monthly |
| Kenora | 6,766 | No | Yes | Complete | None | Yes | 1938 | 5 | 0 | 3,000 qts. | 100 | Semi-annually |
| Kingston | 23,439 | Yes | Yes | 43% | 12% | Yes | 1935 | 10 | 0 | 11,175 qts. | 100 | Monthly |
| Kingsville | 2,174 | No | Yes | None | — | Yes | 1938 | 2 | 0 | 1,000 qts. | 100 | Monthly |
| Kirkland Lake | 9,915 | Yes | Yes | Complete | None | Yes | 1931 | 4 | 0 | 7,230 qts. | 100 | Monthly |
| Kitchener | 30,793 | Yes | Yes | Complete | Part | Yes | 1938 | 11 | 0 | 10,800 qts. | 100 | Weekly |
| Leamington | 4,902 | No | No | Part | Part | Yes | 1928 | 3 | 0 | 1,400 qts. | 100 | Monthly |
| London | 71,148 | Yes | Yes | Complete | 10% | Yes | 1938 | 42 | 0 | 24,000 qts. | 100 | Monthly |
| Long Branch | 3,962 | No | No | — | — | Yes | 1931 | 14 | 0 | — | 100 | — |
| Meaford | 2,624 | No | Yes | 37% | Part | Yes | 1931 | 2 | 0 | 650-750 qts. | 100 | Quarterly |
| Merritton | 2,523 | — | Yes | Complete | Complete | Yes | 1937 | 11 | 0 | 1,600 qts. | 100 | Monthly |
| Midland | 6,920 | No | Yes | Part | None | Yes | 1938 | 5 | 0 | 2,167 qts. | 100 | Monthly |
| Mimico | 6,800 | — | — | Complete | Complete | Yes | 1928 | 12 | 0 | — | 100 | Semi-annually |
| Napanee | 3,497 | No | No | 50% | None | Yes | 1938 | 3 | 0 | — | 100 | Semi-annually |
| New Liskeard | 2,880 | Yes | Yes | Complete | 50% | Yes | 1938 | 3 | 0 | 1,200 qts. | 100 | Semi-annually |
| Newmarket | 3,748 | No | Yes | Complete | 24% | Yes | 1936 | 3 | 0 | 1,312 qts. | 100 | Monthly |
| New Toronto | 7,146 | No | No | — | — | Yes | 1935 | 8 | 0 | — | 100 | Quarterly |
| Niagara Falls | 19,046 | Yes | Yes | 90% | 50% | Yes | 1927 | 8 | 0 | 8,000 qts. | 100 | Daily |
| North Bay | 15,528 | Yes | Yes | Complete | Complete | Yes | 1927 | 5 | 0 | 4,440 qts. | 100 | Weekly |
| Oakville | 3,857 | Yes | Yes | Complete | None | Yes | 1916 | 3 | 0 | 1,600 qts. | 100 | Bi-monthly |
| Orangeville | 2,614 | No | Part | Complete | Complete | Yes | 1938 | 3 | 0 | 770 qts. | 100 | Quarterly |
| Orillia | 8,183 | Yes | Yes | 55% | 65% | Yes | 1933 | 9 | 0 | 1,830 qts. | 100 | Weekly |

—Information not supplied.

—Information not supplied.

TABLE I.—*Continued.*

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ontario—Cont.* | | | | | | | | | | | | |
| Oshawa | 23,439 | Yes | Yes | Complete | 33% | Yes | 1927 | 6 | 0 | 11,000 qts. | 100 | Weekly |
| Ottawa | 126,872 | Yes | Yes | Complete | 75% | Yes | 1938 | 16 | 0 | 72,000 qts. | 100 | Weekly |
| Owen Sound | 12,839 | No | Yes | Complete | None | Yes | 1938 | 6 | 0 | 4,500 qts. | 100 | Quarterly |
| Parry Sound | 3,512 | No | No | — | None | Yes | 1938 | 2 | 0 | 995 qts. | 100 | None |
| Pembroke | 9,368 | No | No | None | None | Yes | 1938 | 5 | 0 | 2,800 qts. | 100 | Semi-annually |
| Penetanguishene | 4,035 | Yes | Yes | 50% | None | Yes | 1932 | 2 | 0 | 800 qts. | 100 | Monthly |
| Peterborough | 22,327 | No | Yes | Complete | 50% | Yes | 1938 | 11 | 0 | 12,840 qts. | 100 | Monthly |
| Petrolia | 2,596 | Yes | Yes | 50% | 50% | Yes | 1937 | 2 | 0 | 600 qts. | 100 | Semi-annually |
| Port Arthur | 19,818 | Yes | Yes | Complete | Part | Yes | 1938 | 9 | 0 | 10,437 qts. | 100 | Weekly |
| Port Colborne | 6,503 | Yes | Yes | 30% | None | Yes | 1934 | 3 | 0 | 2,200 qts. | 100 | Monthly |
| Port Hope | 4,723 | No | Yes | Complete | — | Yes | 1938 | 4 | 0 | 1,440 qts. | 100 | Quarterly |
| Prescott | 2,984 | No | Yes | Complete | Part | Yes | 1938 | 4 | 0 | 800 qts. | 100 | Quarterly |
| Preston | 6,280 | Yes | Yes | — | None | Yes | 1938 | 6 | 0 | 1,600 qts. | 100 | Irregularly |
| Renfrew | 5,296 | Yes | Yes | 75% | Complete | Yes | 1938 | 4 | 0 | 2,000 qts. | 95 | Monthly |
| Rockland | 2,118 | — | — | Complete | None | Yes | 1938 | 1 | — | — | — | Monthly |
| St. Catharines | 24,753 | Yes | Yes | Complete | 20% | Yes | 1931 | 9 | 0 | 11,000 qts. | 100 | Monthly |
| St. Marys | 3,802 | Yes | Yes | 50% | None | Yes | 1938 | 2 | 0 | 900 qts. | 100 | Monthly |
| St. Thomas | 15,430 | No | Yes | 90% | Part | Yes | 1928 | 5 | 0 | 8,000 qts. | 100 | Quarterly |
| Sault Ste. Marie | 23,082 | Yes | Yes | Complete | Part | Yes | 1938 | 6 | 0 | 5,000 qts. | 100 | Quarterly |
| Simcoe | 5,226 | No | No | Part | Part | Yes | 1938 | 2 | Few | — | 96 | Monthly |
| Sioux Lookout | 2,088 | Yes | No | Complete | None | Yes | 1938 | 2 | 0 | 478 qts. | 100 | Quarterly |
| Smiths Falls | 7,108 | Yes | Yes | Complete | — | Yes | 1938 | 7 | 0 | 2,500 qts. | 100 | Monthly |
| Stratford | 17,742 | No | Yes | 58% | 10% | Yes | 1938 | 5 | 0 | 4,918 qts. | 100 | Bi-monthly |
| Sturgeon Falls | 4,234 | No | Yes | None | None | Yes | 1938 | 2 | 0 | 400 qts. | 100 | Regularly |
| Sudbury | 18,518 | Yes | Yes | None | None | Yes | 1925 | 5 | 0 | 11,213 qts. | 100 | Weekly |
| Tecumseh | 2,129 | No | No | Part | — | Yes | 1938 | 6 | 8 | 600 qts. | 92 | Weekly |
| Thorold | 5,092 | Yes | Yes | 10% | None | Yes | 1937 | 5 | 0 | 1,340 qts. | 100 | Monthly |
| Tilsonburg | 3,385 | Yes | Yes | Complete | Part | Yes | 1938 | 4 | 0 | 1,524 qts. | 100 | Weekly |
| Walkerton | 2,431 | No | Yes | 90% | None | Yes | 1932 | 3 | 0 | 650 qts. | 100 | Regularly |
| Wallaceburg | 4,326 | No | No | Part | None | Yes | 1937 | 2 | 0 | — | 100 | Semi-annually |
| Waterloo | 8,095 | Yes | Yes | Complete | Part | Yes | 1938 | 11 | 0 | 2,720 qts. | 100 | Weekly |
| Welland | 10,709 | Yes | Yes | 15% | 10% | Yes | 1919 | 5 | 0 | 4,700 qts. | 100 | Monthly |
| Weston | 4,723 | No | Yes | Complete | Part | Yes | 1938 | 12 | 0 | — | 100 | Monthly |
| Whitby | 5,046 | No | No | Complete | — | Yes | 1933 | 4 | 0 | 2,100 qts. | 100 | Weekly |
| Windsor | 98,203 | No | Yes | 40% | 20% | Yes | 1921 | 10 | 0 | 34,384 qts. | 100 | Bi-weekly |
| Woodstock | 11,395 | Yes | Yes | Complete | 75% | Yes | 1938 | 5 | 0 | 4,300 qts. | 100 | Daily |

—Information not supplied.

TABLE I.—*Continued.*

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Quebec* | | | | | | | | | | | | |
| Almaville | 2,010 | Yes | Yes | 50% | None | No | | 1 | 10 | 600 qts. | 17 | Monthly |
| Amos | 2,153 | Yes | Yes | Complete | None | No | | 0 | 7 | 600 qts. | 0 | Monthly |
| Asbestos | 4,396 | Yes | Yes | Complete | Part | No | | 1 | 5 | 2,200 qts. | 32 | Bi-monthly |
| Aylmer | 2,835 | Yes | Yes | Part | None | No | | 0 | 1 | — | — | Regularly |
| Bagotville | 2,468 | No | Yes | Complete | None | No | | 0 | 9 | 480 qts. | 0 | Monthly |
| Beauharnois | 3,729 | Yes | No | Complete | Part | No | | 0 | 10 | 800 qts. | 0 | Annually |
| Black Lake | 2,167 | No | No | Complete | 25% | No | | 0 | — | — | 0 | None |
| Buckingham | 4,638 | Yes | Yes | Complete | 35% | No | | 1 | 8 | 750 qts. | 35 | Quarterly |
| Cabano | 2,187 | Yes | Yes | Complete | 20% | No | | 0 | 3 | 360 qts. | 0 | Semi-annually |
| C. de la Madeleine | 8,748 | Yes | Yes | Complete | Part | No | | 1 | 28 | 3,440 qts. | 11 | Bi-monthly |
| Chicoutimi | 11,877 | Yes | Yes | Complete | None | No | | 1 | 13 | 2,820 qts. | 24 | Monthly |
| Dolbeau | 2,032 | Yes | Yes | Complete | None | No | | 3 | 3 | 1,290 qts. | 59 | Bi-monthly |
| Donnacona | 2,631 | Yes | Yes | Complete | None | No | | 1 | 6 | 940 qts. | 15 | Monthly |
| Drummondville | 6,609 | Yes | Yes | Complete | 10% | Yes* | 1918 | 5 | 2 | 2,500 qts. | 92 | Monthly |
| East Angus | 3,566 | Yes | Yes | Complete | 25% | No | | 0 | 8 | 640 qts. | 0 | Quarterly |
| Farnham | 4,205 | Yes | Yes | Complete | 8% | No | | 1 | 7 | 750 qts. | 23 | Monthly |
| Granby | 10,587 | Yes | Yes | Complete | 5% | No | | 1 | 34 | 4,000 qts. | 20 | Quarterly |
| Grand'Mere | 6,461 | Yes | Yes | Complete | None | No | | 1 | 23 | 1,490 qts. | 10 | Weekly |
| Hull | 29,433 | Yes | Yes | Complete | None | No | | 8 | 13 | 12,000 qts. | 70 | Monthly |
| Iberville | 2,778 | Yes | Yes | Complete | 10% | No | | 2 | 8 | 1,760 qts. | 75 | Monthly |
| Joliette | 10,765 | Yes | Yes | Complete | Complete | No | | 0 | 24 | 3,600 qts. | 0 | Bi-monthly |
| Jonquiere | 9,448 | Yes | Yes | Complete | None | No | | 2 | 4 | 2,280 qts. | 70 | Monthly |
| Kenogami | 4,500 | Yes | Yes | Complete | None | No | | 1 | 2 | 1,320 qts. | 91 | Monthly |
| Lachine | 18,630 | No | Yes | Complete | None | No | | 10 | 3 | 5,600 qts. | 82 | Monthly |
| Lachute | 3,906 | Yes | Yes | Complete | None | No | | 0 | 6 | 1,340 qts. | 0 | Bi-monthly |
| Laprairie | 2,774 | Yes | Yes | Complete | 5% | No | | 1 | 9 | 1,280 qts. | — | Quarterly |
| La Salle | 2,362 | Yes | Yes | Complete | Part | No | | 1 | Many | 800 qts. | 80 | Monthly |
| La Tuque | 7,871 | Yes | Yes | Complete | None | No | | 0 | 21 | 1,530 qts. | 0 | Bi-monthly |
| Lauzon | 7,084 | Yes | Yes | Complete | 1% | No | | 1 | 37 | 1,300 qts. | 20 | Quarterly |
| Laval des Rapides | 2,716 | Yes | No | — | — | No | | — | 2 | — | — | None |
| Levis | 11,724 | Yes | Yes | Complete | 3% | No | | 1 | 45 | 2,672 qts. | 18 | Quarterly |
| Longueuil | 5,407 | No | Yes | Complete | Part | No | | 6 | 8 | — | — | Weekly |
| Louiseville | 2,365 | Yes | Yes | Complete | 10% | No | | 0 | 11 | 800 qts. | 0 | Bi-monthly |
| Masson | 2,015 | No | Yes | Complete | None | No | | 0 | 3 | 300 qts. | 0 | Quarterly |
| Megantic | 3,911 | Yes | Yes | Complete | — | No | | 0 | 15 | 1,100 qts. | 0 | Bi-monthly |
| Mont Laurier | 2,394 | No | Yes | Complete | 30% | No | | 0 | 5 | 500 qts. | 0 | Monthly |
| Montreal | 818,577 | Yes | Yes | Complete | 20% | Yes† | 1925 | 27 | 37 | 283,800 qts. | 95 | Monthly |
| Montreal East | 2,242 | Yes | Yes | Part | None | No | | 12 | 5 | 256 qts. | 47 | Monthly |

—Information not supplied. *Special milk allowed. †Special raw milk allowed.

TABLE I.—*Continued.*

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Quebec—Cont.* | | | | | | | | | | | | |
| Montreal North | 4,519 | Yes | Yes | Complete | Complete | No | | Many | — | 2,000 qts. | 90 | — |
| Montreal West | 3,190 | Yes | Yes | Complete | — | Yes | 1939 | (Montreal) | 0 | — | 100 | Monthly |
| Mont Royal | 2,174 | Yes | Yes | — | — | No | | — | 1 | — | — | Monthly |
| Nicolet | 2,868 | Yes | Yes | Complete | None | No | | 1 | 3 | 2,240 qts. | 30 | Weekly |
| Outremont | 28,641 | Yes | Yes | Complete | Part | Yes | 1939 | 20 | 0 | 8,000 qts. | 100 | Monthly |
| Plessisville | 2,536 | Yes | Yes | Complete | Complete | No | | 0 | 10 | 500 qts. | 0 | Monthly |
| Pointe à Gatineau | 2,282 | No | Yes | Complete | None | No | | 3 | 7 | 800 qts. | 30 | Monthly |
| Pte. aux Trembles | 2,970 | Yes | Yes | Complete | Complete | No | | — | 8 | 1,068 qts. | 14 | — |
| Pointe Claire | 4,058 | Yes | No | Complete | 10% | No | | — | 6 | 1,168 qts. | 50 | Irregularly |
| Port Alfred | 2,342 | No | Yes | Complete | None | No | | 0 | 9 | 624 qts. | 0 | Monthly |
| Priceville | 2,310 | No | Yes | Complete | None | No | | 0 | 3 | 300 qts. | 0 | Monthly |
| Quebec | 130,594 | Yes | Yes | Complete | None | No | | 9 | 154 | 44,400 qts. | 65 | Weekly |
| Richmond | 2,596 | Yes | Yes | Complete | Complete | No | | 1 | 4 | 1,400 qts. | 28 | Bi-monthly |
| Rimouski | 5,589 | Yes | Yes | Complete | Complete | No | | 0 | 22 | 1,400 qts. | 0 | Monthly |
| Riviere-du-Loup | 8,499 | Yes | Yes | Complete | 20% | No | | 0 | 26 | 2,000 qts. | 0 | Quarterly |
| Roberval | 2,770 | Yes | Yes | Complete | None | No | | 3 | 3 | 1,290 qts. | 59 | Bi-monthly |
| Saindon | 2,355 | Yes | Yes | 70% | None | No | | 0 | 7 | 280 qts. | 0 | Monthly |
| Ste. Agathe des Monts | 2,949 | Yes | Yes | Complete | Complete | No | | 1 | 11 | 1,300 qts. | 35 | Bi-monthly |
| Ste. Anne de Bellevue | 2,417 | Yes | Yes | Complete | — | No | | 1 | 12 | 1,332 qts. | 18 | Quarterly |
| Ste. Rose | 1,661 | Yes | Yes | Complete | — | No | | — | 4 | 800 qts. | 20 | Bi-monthly |
| Ste. Therese | 3,292 | Yes | Yes | Complete | Complete | No | | 0 | 6 | 600 qts. | 0 | Bi-monthly |
| St. Hyacinthe | 15,448 | Yes | Yes | Complete | Part | No | | 1 | 28 | 6,800 qts. | 18 | Semi-annually |
| St. Jean | 11,256 | Yes | Yes | Complete | 10% | No | | 4 | 17 | 5,500 qts. | 75 | Monthly |
| St. Jerome | 8,967 | Yes | Yes | Complete | Complete | No | | 2 | 7 | 3,200 qts. | 45 | Bi-monthly |
| St. Joseph d'Alma | 3,970 | Yes | Yes | Complete | None | No | | 3 | 3 | 1,290 qts. | 59 | Bi-monthly |
| St. Joseph de Grantham | 2,812 | Yes | Yes | Complete | 10% | No | | 5 | 10 | 3,000 qts. | 33 | Monthly |
| St. Lambert | 6,075 | No | Yes | Complete | Complete | Yes | 1920 | 5 | 0 | 1,600 qts. | 100 | Weekly |
| St. Pierre | 4,185 | No | Yes | Complete | Complete | No | | — | 4 | 900 qts. | 85 | Monthly |
| Shawinigan Falls | 15,345 | Yes | Yes | 95% | None | No | | 1 | 30 | 5,300 qts. | 43 | Monthly |
| Sherbrooke | 28,933 | Yes | Yes | Complete | — | No | | 2 | 75 | 17,440 qts. | 10 | Semi-annually |
| Thetford Mines | 10,701 | Yes | Yes | Complete | 25% | No | | 1 | 30 | 750 qts. | 33 | Monthly |
| Trois Rivieres | 35,450 | Yes | Yes | Complete | 10% | No | | 5 | 60 | 15,000 qts. | 60 | Weekly |
| Verdun | 60,745 | Yes | Yes | Complete | 15% | Yes | 1938 | 26 | 0 | 18,000 qts. | 100 | Bi-weekly |
| Victoriaville | 6,213 | Yes | Yes | Complete | 5% | No | | 1 | 32 | 2,000 qts. | 40 | Weekly |
| Westmount | 24,235 | Yes | Yes | Complete | 40% | Yes | 1937 | 30 | 0 | 6,000 qts. | 100 | Quarterly |
| Windsor | 2,720 | Yes | Yes | Complete | None | No | | 0 | 3 | 500 qts. | 0 | Monthly |

—Information not supplied.

TABLE I.—*Continued.*

| Place | Population (1931) | Dairy farm licence required | Dairy farms inspected | Tuberculin testing of cattle | Contagious abortion testing of cattle | Compulsory pasteurization | Date of law if compulsory | Pasteurization plants serving community | Raw milk dairies in community | Amount of fluid milk daily | Percentage pasteurized | Inspection of dairies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *New Brunswick* | | | | | | | | | | | | |
| Bathurst | 3,300 | Yes | Yes | Complete | 10% | No | | 1 | 14 | — | — | Monthly |
| Campbellton | 6,505 | Yes | Yes | Complete | None | No | | 2 | 55 | 1,800 qts. | 40 | Monthly |
| Chatham | 4,017 | Yes | Yes | Complete | None | No | | 0 | 29 | 676 qts. | 0 | Annually |
| Edmunston | 6,430 | Yes | Yes | Complete | None | No | | 1 | — | — | — | Semi-annually |
| Fredericton | 8,830 | Yes | Yes | Complete | None | No | | 2 | 30 | — | 25 | — |
| Moncton | 20,689 | Yes | Yes | Complete | Part | No | | 3 | 99 | 8,800 qts. | 22 | Bi-monthly |
| Newcastle | 3,383 | Yes | Yes | Complete | None | No | | 1 | 12 | 644 qts. | 19 | Annually |
| Sackville | 2,234 | Yes | Yes | Complete | Part | No | | 1 | 8 | 770 qts. | 8 | Bi-monthly |
| Saint John | 45,514 | Yes | Yes | Complete | Part | No | | 6 | 14 | 19,382 qts. | 65 | Daily |
| St. Stephen | 3,437 | No | No | Complete | Part | No | | 0 | — | — | 0 | None |
| *Nova Scotia* | | | | | | | | | | | | |
| Amherst | 7,450 | Yes | Yes | 75% | None | No | | 1 | 38 | — | — | Monthly |
| Bridgewater | 3,262 | No | No | None | None | No | | 1 | 7 | 800 qts. | 42 | None |
| Dominion | 2,846 | No | Yes | 50% | None | No | | 5 | 2 | 350 qts. | 75 | Weekly |
| Halifax | 59,275 | Yes | Yes | 70 % | 10% | No | | 12 | 2 | 25,000 qts. | 96 | Weekly |
| Inverness | 2,900 | No | Yes | None | None | No | | 0 | 6 | — | — | Semi-annually |
| Kentville | 3,033 | Yes | Yes | Complete | None | No | | 3 | 4 | 1,775 qts. | 79 | Monthly |
| Liverpool | 2,669 | No | Yes | None | None | No | | 1 | 3 | 700 qts. | 57 | Semi-annually |
| Lunenburg | 2,727 | No | No | None | None | No | | 1 | 4 | 600 qts. | 25 | None |
| New Glasgow | 8,858 | No | Yes | 30% | 30% | No | | 3 | Many | 5,000 qts. | 16 | Semi-annually |
| New Waterford | 7,745 | No | No | None | None | No | | 3 | 9 | — | — | — |
| North Sydney | 6,139 | — | Yes | None | None | No | | — | 11 | 905 qts. | 15 | Quarterly |
| Pictou | 3,152 | No | No | None | Part | No | | 0 | 11 | 800 qts. | 0 | — |
| Springhill | 6,355 | No | Yes | Complete | Onrequest | No | | 1 | 34 | — | 16 | Annually |
| Stellarton | 5,002 | No | No | Complete | None | No | | 2 | 12 | 1,511 qts. | 31 | None |
| Sydney | 23,089 | Yes | Yes | None | None | No | | 5 | 17 | 6,934 qts. | 75 | Weekly |
| Sydney Mines | 7,769 | No | No | Part | None | No | | 1 | 7 | 1,500 qts. | 20 | Annually |
| Trenton | 2,613 | No | No | 75% | None | No | | 1 | 12 | 720 qts. | 10 | None |
| Westville | 3,946 | No | Yes | Complete | — | No | | 0 | 12 | — | 0 | — |
| Windsor | 3,032 | Yes | Yes | Complete | 5% | No | | 1 | 3 | — | 15 | Rarely |
| Yarmouth | 7,055 | Yes | Yes | Complete | 50% | No | | 2 | 19 | 2,600 qts. | 35 | Monthly |
| *Prince Edward Island* | | | | | | | | | | | | |
| Charlottetown | 12,361 | Yes | Yes | Complete | None | No | | 5 | 29 | 2,450 qts. | 70 | Semi-annually |

—Information not supplied.

# Survey of Milk-Borne Diseases in Canada

## COMPILED BY THE MILK COMMITTEE OF THE CANADIAN PUBLIC HEALTH ASSOCIATION

### TABLE I

MILK-BORNE DISEASES IN CANADA AS RECORDED BY PROVINCES AND MUNICIPALITIES 1912-1936

| *Year* | *Municipality* | *Province* | *Disease* | *Cases* | *Deaths* |
|---|---|---|---|---|---|
| 1912 | Winnipeg | Manitoba | Typhoid fever | 92 | 7 |
| 1913 | Calgary | Alberta | Scarlet fever | 13 | 0 |
| 1916 | Winnipeg | Manitoba | Typhoid fever | 23 | 0 |
| 1918 | Quebec City | Quebec | Typhoid fever | 23 | 2 |
| 1919 | Winnipeg | Manitoba | Scarlet fever | 73 | 0 |
| 1920 | Regina | Saskatchewan | Typhoid fever | 83 | 9 |
| 1921 | Montreal | Quebec | Typhoid fever | 5 | 0 |
| 1921 | Bowmanville | Ontario | Typhoid fever | 6 | 0 |
| 1921 | Vinelands | Ontario | Typhoid fever | 20 | 0 |
| 1922 | Quebec City | Quebec | Typhoid fever | 14 | 3 |
| 1922 | Montreal | Quebec | Typhoid fever | 33 | 3 |
| 1922 | Winnipeg | Manitoba | Scarlet fever | 29 | 0 |
| 1922 | Winnipeg | Manitoba | Scarlet fever | 10 | 0 |
| 1923 | Saint John | New Brunswick | Typhoid fever | 10 | 0 |
| 1923 | Sherbrooke | Quebec | Typhoid fever | 7 | 2 |
| 1923 | Arnprior | Ontario | Typhoid fever | 6 | 0 |
| 1923 | Hanover | Ontario | Typhoid fever | 46 | 4 |
| 1924 | Long Branch | Ontario | Typhoid fever | 13 | 0 |
| 1924 | Montreal | Quebec | Typhoid fever | 16 | 2 |
| 1924 | Cobalt | Ontario | Typhoid fever | 6 | 0 |
| 1924 | Quebec City | Quebec | Typhoid fever | 8 | 0 |
| 1924 | Quebec City | Quebec | Paratyphoid fever | 5 | 0 |
| 1925 | Winnipeg | Manitoba | Scarlet fever | 28 | 0 |
| 1925 | Winnipeg | Manitoba | Typhoid fever | 9 | 2 |
| 1926 | Winnipeg | Manitoba | Typhoid fever | 15 | 0 |
| 1927 | Montreal | Quebec | Typhoid fever | 5,002 | 533 |
| 1927 | Chatham | Ontario | Typhoid fever | 109 | 7 |
| 1927 | Quebec City | Quebec | Typhoid fever | 12 | 0 |
| 1928 | Quebec City | Quebec | Typhoid fever | 20 | 4 |
| 1928 | Dundas | Ontario | Typhoid fever | 13 | 0 |
| 1928 | Timmins | Ontario | Typhoid fever | 10 | 0 |
| 1928 | Sturgeon Falls | Ontario | Typhoid fever | 12 | 0 |
| 1928 | Lake Scugog | Ontario | Typhoid fever | 3 | 1 |
| 1929 | Edmonton | Alberta | Scarlet fever | 28 | 0 |
| 1929 | Ameliasburg | Ontario | Typhoid fever | 17 | 2 |
| 1930 | Belleville | Ontario | Typhoid fever | 18 | 3 |
| 1930 | Kirkland Lake | Ontario | Septic sore throat | 457 | 4 |
| 1930 | S. Westminster | British Columbia | Typhoid fever | 14 | 1 |
| 1930 | Montreal | Quebec | Typhoid fever | 130 | 26 |
| 1930 | Montreal | Quebec | Typhoid fever | 96 | 12 |
| 1931 | Kitchener | Ontario | Scarlet fever | 11 | 0 |
| 1931 | St. Catharines | Ontario | Paratyphoid fever | 487 | 3 |
| 1931 | Surrey | British Columbia | Typhoid fever | 14 | 1 |
| 1931 | Hampton | New Brunswick | Typhoid fever | 7 | 0 |
| 1931 | La Pérade | Quebec | Typhoid fever | 29 | 2 |
| 1931 | Dauphin | Manitoba | Septic sore throat | 100 | 0 |
| 1932 | St. Maurice Valley | Quebec | Typhoid fever | 527 | 45 |
| 1933 | St. Catharines | Ontario | Paratyphoid fever | 30 | 0 |
| 1933 | Carman | Manitoba | Typhoid fever | 15 | 1 |
| 1933 | Port Elgin | Ontario | Septic sore throat | 27 | 0 |
| 1933 | Kingston | Ontario | Typhoid fever | 19 | 0 |
| 1933 | St. Eustache | Quebec | Typhoid fever | 27 | 2 |
| 1934 | Moose Jaw | Saskatchewan | Brucellosis | 21 | 0 |
| 1934 | Edmunston | New Brunswick | Typhoid fever | 12 | 0 |

TABLE I—Continued

| *Year* | *Municipality* | *Province* | *Disease* | *Cases* | *Deaths* |
|---|---|---|---|---|---|
| 1934–35 | Shawinigan Falls | Quebec | Typhoid fever | 59 | 5 |
| 1935 | Minnedosa | Manitoba | Brucellosis | 4 | 0 |
| 1929–36 | (Province) | Ontario | Brucellosis | 758 | 0 |
| 1936 | Spring Bank | Alberta | Typhoid fever | 4 | 0 |
| 1936 | Thorsby | Alberta | Typhoid fever | 9 | 0 |
| 1936 | Edmonton | Alberta | Typhoid fever | 9 | 0 |

## TABLE II

MILK-BORNE DISEASES IN CANADA AS RECORDED BY PROVINCES, 1937-1940

| *Year* | *Province* | *Disease* | *Cases* | *Deaths* |
|---|---|---|---|---|
| 1937 | Saskatchewan | Typhoid fever | 63 | 9 |
| 1937 | Quebec | Typhoid and paratyphoid fevers | 12 | Not stated |
| 1937 | Ontario | Paratyphoid fever | 11 | 0 |
| 1937 | Quebec | Brucellosis | 31 | Not stated |
| 1937 | British Columbia | Brucellosis | 15 | 0 |
| 1937 | Alberta | Brucellosis | 7 | 0 |
| 1937 | New Brunswick | Brucellosis | 1 | 0 |
| 1937 | Manitoba | Brucellosis | 10 | 0 |
| 1937 | Saskatchewan | Brucellosis | 5 | 0 |
| 1937 | Ontario | Brucellosis | 80 | 3 |
| 1938 | British Columbia | Typhoid fever | 36 | 2 |
| 1938 | Alberta | Typhoid fever | 8 | 0 |
| 1938 | Quebec | Brucellosis | 36 | Not stated |
| 1938 | British Columbia | Brucellosis | 16 | 0 |
| 1938 | Alberta | Brucellosis | 4 | 0 |
| 1938 | Manitoba | Brucellosis | 4 | 0 |
| 1938 | Saskatchewan | Brucellosis | 1 | 0 |
| 1938 | Ontario | Brucellosis | 82 | 2 |
| 1939 | Manitoba | Typhoid fever | 7 | 0 |
| 1939 | Quebec | Typhoid and paratyphoid fevers | 3 | Not stated |
| 1939 | Quebec | Brucellosis | 59 | Not stated |
| 1939 | British Columbia | Brucellosis | 10 | 0 |
| 1939 | Alberta | Brucellosis | 2 | 0 |
| 1939 | Manitoba | Brucellosis | 4 | 0 |
| 1939 | Ontario | Brucellosis | 60 | 2 |
| 1940 | Manitoba | Typhoid fever | 94 | 11 |
| 1940 | Quebec | Typhoid and paratyphoid fevers | 73 | Not stated |
| 1940 | Quebec | Brucellosis | 34 | Not stated |
| 1940 | British Columbia | Brucellosis | 10 | 0 |
| 1940 | Alberta | Brucellosis | 7 | 0 |
| 1940 | Manitoba | Brucellosis | 7 | 0 |
| 1940 | Saskatchewan | Brucellosis | 1 | 0 |
| 1940 | Ontario | Brucellosis | 50 | 3 |
| 1940 | Alberta | Septic sore throat | 52 | 0 |

## SUMMARY

CASES AND DEATHS OF MILK-BORNE DISEASES IN CANADA, 1912-1940

| | *Cases* | *Deaths** |
|---|---|---|
| Typhoid and paratyphoid fevers | 7,451 | 704 |
| Scarlet fever | 192 | 0 |
| Septic sore throat | 636 | 4 |
| Brucellosis | 1,319 | 10 |
| Total | 9,598 | 718 |

*Incomplete data.

# EDITORIAL SECTION



## DIETARY CALCIUM DEFICIENCIES IN CANADA

DIETARY surveys recently carried out by the Canadian Council on Nutrition have provided accurate information regarding nutritional conditions in Canadian cities. A serious deficiency of calcium has been made apparent by each survey. This element is essential for the proper formation of bones and teeth and is particularly necessary for growing children. The food surveys show that children in low-income families are receiving about one-half the calcium which they need. This situation has been found in Halifax, Quebec, Toronto, and Edmonton. Public health authorities should be concerned over the existence of a wide-spread nutritional deficiency. Children in low-income families are not obtaining the supply of food which they need for normal growth; they cannot become properly developed adults. In a predominantly agricultural country, frequently embarrassed by surplus crops, a large number of our children are not securing healthful meals.

While a number of foods supply some calcium, we are largely dependent upon milk and cheese for this element. Cheese is the cheapest food source of calcium, yet it is used in many households only as a flavouring and not as a valuable food. The consumption of cheese in Canada is small in comparison with the amount which might be used advantageously. A study of milk consumption indicates clearly the reason for the existence of a calcium deficiency. The survey reported by Dr. Hopper in this issue shows that the use of milk in low-income families is very small; thirty-three per cent of the children in one economic group did not get milk to drink. A similar situation is revealed by the report on milk consumption in Vancouver and is also indicated by a study made by Dr. Sylvestre in the Province of Quebec. Dr. Sylvestre has reported that, even on farms, children fail to secure proper amounts of milk. Children in low-income families have a deficiency of calcium; this is caused by a lack of milk.

There are two reasons why these children are not given the milk which they need for healthy growth: financial inability to purchase milk in adequate amounts and a lack of appreciation of the nutritive value of milk. A family of father, mother, and three children should have, at least, eighteen quarts of milk per

week. At thirteen cents per quart the cost of this milk is $2.34 per week, which is a large amount for a low-income family. No one would deny farmers or dairies a fair return but a major item in the retail price of milk is the cost of distribution. Public health authorities could well give thought to methods of making milk more readily available to low-income families. The existence of a serious deficiency of calcium also demands attention along the lines of education. In many cases inadequate amounts of milk are used because people do not realize its food value. It should be regarded as a "must" food. Even in low-income families better supplies of milk would be obtained if, in the purchase of foods, the housewife was trained to put first things first. It is to be hoped that the obvious lesson from the new data on Canadian nutrition will be appreciated. Canadian children need more milk.

## PASTEURIZATION AND THE NUTRITIVE VALUE OF MILK

LETTERS from well-meaning but uninformed persons occasionally appear in newspapers, questioning the wisdom of pasteurization of milk. The writers of these letters do not doubt that pasteurization kills infective organisms and thus prevents the spread of milk-borne diseases but they do maintain that the nutritive value of pasteurized milk is not so good as that of the raw food. A most effective answer to these claims has been furnished by a series of four reports published in Great Britain by the National Institute for Research in Dairying and the Rowett Research Institute. These two organizations, one well-known for dairy investigations, the other internationally famous for studies on nutrition, co-operated to investigate the effects of pasteurization upon the nutritive value of milk. Using the classical method of nutrition, research studies were made first upon rats. To obviate criticism that this species is not accustomed to live upon cow's milk, investigations were made also on calves. The crucial feature of the research was, however, that carried out on children. The results of all these investigations have been summarized in the fourth and final report; this should be read by all those interested in public health work. Newspapers, which are accustomed to give valuable space to the writers of unfortunate and ill-advised letters against pasteurization, would be better servants of the public if they gave prominence to the authoritative results of this accurate investigation.

Cow's milk is the natural food of the young calf and it may be assumed that this food is exactly suited to meet all the nutritional needs of the calf at the period of its most rapid growth and development. Rapidly growing animals are particularly sensitive to food deficiencies and the calf is the most sensitive test animal which can be used to detect any changes in the nutritive value of milk which might be caused by pasteurization. Carefully conducted experiments showed that there were no differences in growth rate, in general health, or in the composition of the blood between groups of calves fed raw or pasteurized milk. The experiments showed clearly that pasteurized milk has an identical food value with that of raw milk. Similar results were secured in investigations on rats and on

school children. A quotation from the final report should be widely publicized:

"It may, therefore, be concluded that there are no differences between the nutritive values of raw and pasteurized milk of any practical importance for school children who receive milk as part of their ordinary diet."

One result of the experiments on calves amply justifies the work of public health authorities who have worked arduously to protect the public by endeavouring to make pasteurization of milk universal. All of the calves used in the investigations were from tuberculin-tested herds. At the conclusion of the experiment, 46 per cent of the calves fed raw milk gave positive tuberculin tests, compared with 13 per cent of the animals fed on pasteurized milk. A process for making milk safe and which does not impair its nutritive value should be made compulsory throughout Canada. Canadian children need more milk; in securing this essential food they should be protected from tuberculosis, typhoid, and the other infectious diseases which can be spread by raw milk.

## COMPULSORY PASTEURIZATION IN ONTARIO

FOR many years prior to 1938 local municipalities in Ontario were empowered, by provincial legislation, to enact regulations for the control of milk from the public health standpoint. Such legislation provided for the licensing of dairies, the production of clean milk, and the pasteurization of milk. Only fifty municipalities of the eight hundred in the province had passed by-laws requiring the pasteurization of all milk offered for sale. In some municipalities, although there was no by-law, milk was pasteurized voluntarily. Meanwhile the constant danger of milk-borne disease, and the difficulties surrounding the adequate safeguarding of milk by local municipalities, called for the enactment of legislation requiring province-wide pasteurization. In 1938 the Public Health Act of Ontario was amended to provide for such protection. Ontario was the first province or state on this continent to require general pasteurization. The results have been highly gratifying: over ninety-eight per cent of all milk sold in Ontario is now pasteurized. The records of the Department of Health show that already there has been a substantial reduction in the incidence of milk-borne disease. It is noteworthy also that province-wide pasteurization has been introduced without disturbance to the dairy industry. Public opinion is strongly behind the legislation and there is a general recognition that pasteurization alone protects the consumer. To assure that pasteurization plants are properly equipped and operated, approval of such plants must be obtained from the Provincial Department of Health. The Department reviews all applications with particular reference to the equipment and lay-out. Regular inspections are made of all pasteurizing plants in the province, thus aiding the local municipalities in their supervision of milk supplies. Ontario has led the way in demonstrating beyond question that province-wide pasteurization is practicable and effective, and that it is possible for small urban centres and a considerable part of rural areas to have the benefits of pasteurized milk.

## A PROPOSED STANDARD MILK ORDINANCE

THERE is an urgent need in Canada for agreement concerning the essentials in milk control, including minimum standards for the production of clean milk on the dairy farm, the proper conduct of pasteurization, and the sanitary distribution of this product. Such an agreement can best be presented in the form of a standard milk ordinance, the provisions of which could be incorporated into provincial legislation governing milk control or in similar legislation enacted by municipalities. In the United States the Standard Milk Ordinance prepared by the United States Public Health Service has greatly advanced milk control in addition to producing uniformity in procedure which is highly important. With the collaboration of provincial and municipal departments of health and with milk producers' associations, the Milk Committee of the Canadian Public Health Association has prepared a standard milk ordinance for the consideration of federal and provincial health authorities.

A definition of "milk" is an essential part of legislation regarding this food. This and other definitions are included in the ordinance. It will be recalled that the Department of Pensions and National Health, in the administration of the Food and Drugs Act, has taken a strong stand in this matter. The Department has, for instance, required that skim milk to which chocolate flavouring has been added can be sold only under the designation "chocolate dairy drink" and not as "chocolate milk". The term "filled milk" may be new to health officers: it is milk in which the butter fat has been replaced by vegetable oil. These are examples of the problems which demand the defining of "milk" in such a way that the consumer is assured that "milk" means unadulterated whole milk.

Uniformity in regulations issued by the various provinces and municipalities would mean a great strengthening of milk control and would advance greatly the effort to ensure a safe milk supply for every community.

## "TRANSMISSION OF ANIMAL DISEASES TO MAN THROUGH MILK"

THE members of the Editorial Board are deeply indebted to Dr. Mazyck P. Ravenel, Editor Emeritus of the *American Journal of Public Health*, for preparing an article on the transmission of animal diseases to man through milk, for publication in this issue. Quite apart from the excellent presentation of the subject, Dr. Ravenel has recorded historical facts which have been but little known. Readers of the JOURNAL will be pleased to learn that he has consented to record, in a subsequent article, an outline of the development of our knowledge of bovine tuberculosis, in the early investigations of which he made highly important contributions.